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Recent Installations

HYDRAULIC TURBINES

DIVISION OF PLANT OPERATION
AUG 5 1932
U. S. RECLAMATION SERVICE

S·MORGAN SMITH COMPANY

1877 1929

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The cover illustration shows a night view of the Tugalo Plant of the Georgia Power Co. where four Smith turbines are each developing 22,500 H. P. at 171.4 R. P. M. under 150 feet head.

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FOREWORD

THE great wheels of industry can never be stilled for an accounting; nor can the spirit that moves vast enterprise be caught and crystallized for a moment, lest the history of the future remain unwritten, and those turning wheels of industry slow in revery.

Yet, the S. Morgan Smith Company, in the year following its 50th Anniversary, may pause for a moment to take account of its progress since its inception in 1877. We wish to pay tribute to the faith and devotion of those who have given their working lives, wholly or in part, to the advancement of this organization; and we wish to acknowledge our debt to those whose loyalty and patronage have made our continued existence possible.

That is the basic purpose of this Bulletin.

And the purpose becomes three-fold, for it is a dedication to the memory of our Founder; a message of tribute to the friends whom our Company serves, and an account of some of the Company's recent accomplishments in the way of mammoth installations—mighty landmarks of industrial progress, which we hope will inspire the engineer and quicken the spirit of enterprise.

S. MORGAN SMITH CO.

S. Morgan Smith

Founder

S. MORGAN SMITH COMPANY

HISTORICAL FACTS

THE great hydraulic developments of today owe their existence to the engineers and inventors of the nineteenth century, who sought and found methods by which turbine principles, then but little known, could be applied practically for the production of Power.

Stephen Morgan Smith, the founder of the modern S. Morgan Smith Company, was one of the pioneers in this work. He was born in Davie County, North Carolina, February 1st, 1839, and began his education in the public schools of that county, evincing a decided preference for machinery as a pursuit aside from his studies. From the Davie County Schools he entered the Moravian College, at Bethlehem, Pa., and continued his studies for the ministry. He graduated in 1861 and for the next ten years he headed the Moravian Churches in York, Pa., and Canal Dover, Ohio.

Ill health caused him to retire from the ministry and turn to other fields for support. His boyhood bent had been machinery and it was quite natural for him in his maturity, to pursue his studies and experiments in this field.

In 1876, about six years after his retirement from the ministry, he was attracted to the possibilities of water power and its application to mill machinery. His experiments proved successful and he invented a turbine water wheel which was favorably received by the milling industry, so that he secured a first order for a 30-inch water wheel, to be known as the "Success" turbine.

This venture convinced him that he was on the right track. He began operations in a modest way, designing the turbines himself and contracting the work to be done under his supervision in several of the York factories.

From the very first he had known of the great possibilities latent in hydraulic power developments and he possessed the vision to see what the later developments would mean to all industries. And with his vision, S. Morgan Smith possessed determination and energy. Sound, upright business principles characterized his administration, and these traits led to the development of a successful business, so that in the later years of his life he had the satisfaction of seeing his work and knowing that it was to endure. The foundations were strong.

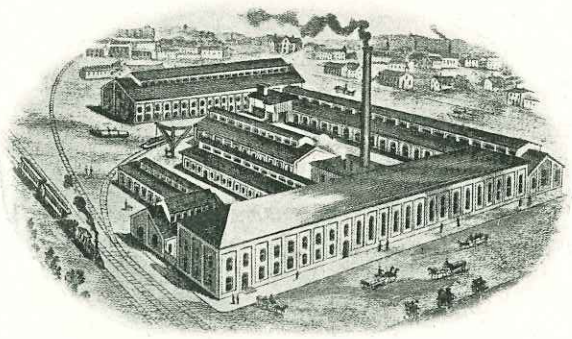
But the growth was not phenomenal. It was only after 13 years that he built his own factory—a building 50 × 150 feet—with a working force of less than twenty mechanics. For equipment he had a 96″ and a 54″ boring mill, an 8′-0″ shafting lathe, a Gleason gear-cutter, and two small drill presses. This was adequate for a beginning. On the 10th of May, 1890, this plant started production.

Steadily the organization advanced. In 1898 the name of S. Morgan Smith was perpetuated in the organization. Gradually the Founder began to rely on his sons to conduct the management of the business.

During the next five years S. Morgan Smith spent much of his time in travel. On one of his visits to California a

sudden illness overtook him, which proved fatal on April 12, 1903.

Seven years later a modern factory was built over and around the original S. Morgan Smith plant, and such extensions and additions have been made thenceforward to enable the organization to keep up with the capacity requirements of the industry and the increasing dimensions of hydraulic turbines.



The Original Factory

As can be seen, the history of the S. Morgan Smith Co. is not spectacular, nor can its growth be compared with that of many vast organizations which spring from conception to substantial power over night; but it has grown slowly, surely,—ever apace with the march of industrial progress.

The goal has never been to develop a gigantic plant with acres upon acres of floor space, and a distributing organization of world-wide extent; rather the ideal has been a compact and efficient manufacturing unit, producing a highly specialized product, and marketing that product through its own organization. The aim has been to concentrate to a high degree, and to perform well—to keep faith with employee and customer, and to make certain that expediency and profit should be subordinated to the permanent good will of those who use S. Morgan Smith products.

Rebuilding the Factory in 1910

No other type of prime mover has contributed more to the growth of the electrical industry, perhaps, than the modern hydraulic turbine, as developed from the first designs of the Founder.

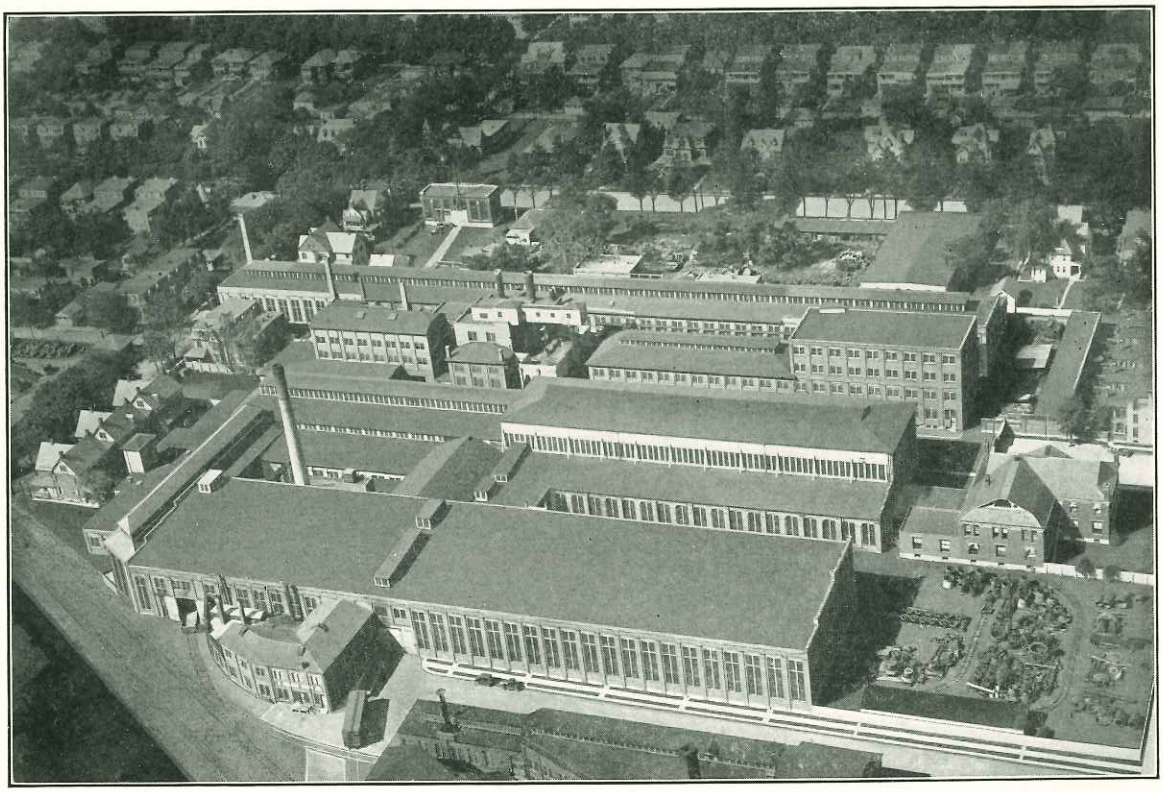
The S. Morgan Smith Co. helped to promote the installation of the first long distance electric transmission system in this country, and built the four horizontal-shaft twin turbine units installed in the Folsom, California plant of the Sacramento Electric Power and Light Co., under a fifty-five foot head, which developed 5,000 horsepower. The electric current thus generated was transmitted to the City of Sacramento, twenty-three miles away, a record for long distance transmission at that time.

Huge hydro-electric plants have been built since that day—great centers of power developing a stupendous amount of electrical energy; and the S. Morgan Smith Company has ever ex-

panded to meet the demand for greater turbine units throughout the civilized world.

So that today, the S. Morgan Smith Company stands foremost among the pioneer firms known as leaders in the field of specialized high-class machinery. The plant is recognized as the world's largest devoted to the manufacture of hydraulic turbines and allied accessories. Our designs include reaction type runners for every practical speed for low, medium and high head developments and in the low head field we also offer high speed axial flow runners of both the fixed and the Kaplan automatically adjustable blade types. Included in the accessories manufactured are actuator and gate shaft type governors with individual or central pumping systems; Gibbs oil bath thrust bearings for vertical or horizontal shafts; plate steel spiral casings, draft tubes and penstocks; steel roller gates, hoists and appurtenances; gate valves, butterfly valves and Dow disc-arm pivot valves; relief valves and pressure regulators; head gates, taintor gates, sluice gates and waste gates; the varied hoisting mechanisms for such gates; and all types of special machinery for hydraulic power development.

The pages which follow are intended to show by picture, rather than by words, some of the achievements in the field of hydraulic engineering.



Aeroplane View of the Present Office and Factory

HYDRAULIC TESTING LABORATORY FACILITIES AND METHODS

Figure 1

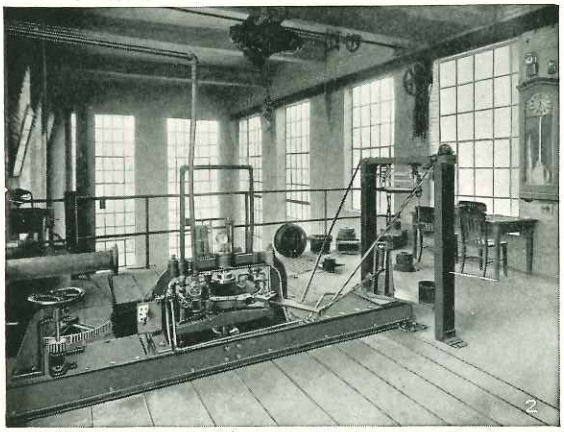


Figure 2

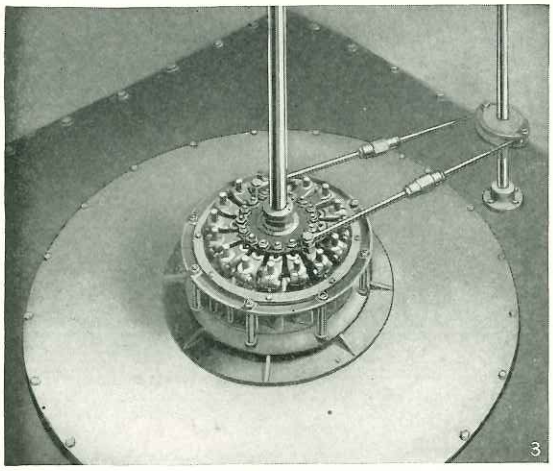


Figure 3

The designing of modern high efficiency turbines, with various types of draft-tubes and intake and discharge passages has been a specialty with this Company from year to year. Further development of the art has recently been greatly facilitated by the establishment here at our plant of one of the most modern hydraulic testing laboratories in existence, thoroughly equipped for exceptionally accurate work.

Exterior view (Figure 1) shows the building to be of liberal dimensions, allowing ample space for equipment and test apparatus. The normal head available for test purposes is ten feet, but this can be varied to any head between five and sixty feet. The head on the turbine is a gravity head, and the water after passing through the turbine flows over a measuring weir, discharging into a roomy pit with a return passage leading to the suction of a motor driven pump unit which lifts the water to a baffle chamber, thence to the flume proper.

The interior view (Figure 2) shows the operating floor, where the power is absorbed by an Alden Absorption Dynamometer. A Fairbanks Beam Scale is used which is hung on a beam supported from the working deck. An electrically operated revolution counter is used to indicate the speed at which the turbine is operating. Hook gauges are used for obtaining the depth of water over the weir. The head is measured by float gauges so arranged that they can be readily checked. The times for making the readings are given by a double pendulum electric clock with a warning bell before the proper time to read.

Figure 3 shows the flume floor with turbine in position. The depth and size of the flume and tail pit are arranged so that either horizontal or vertical wheels can be tested. There is ample provision for easily varying the head and the relation of the center of the turbine with the head and tail water, and sufficient space is available to test almost any conceivable shape or size of intake or discharge passage.

HYDRAULIC TESTING LABORATORY FACILITIES AND METHODS

Of the two model draft-tubes used for test purposes in our laboratory shown in Figure 4, one shows plate glass inserts to permit viewing of action of the water passing through it. Many other models of practically every known type have been tested under all possible conditions.

These tests have been carefully tabulated and reduced to comparative curves, so that the performance of any Smith runner is very definitely known in connection with any known type of draft-tube.

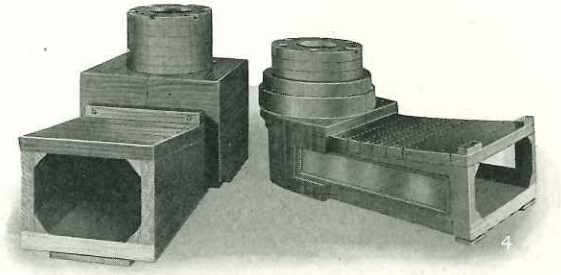


Figure 4

Figure 5 shows a special arrangement in connection with model draft-tube tests, in which equipment has been installed for determining pressures and velocities by means of pitot tubes, and for measuring the discharge therefrom over a weir.

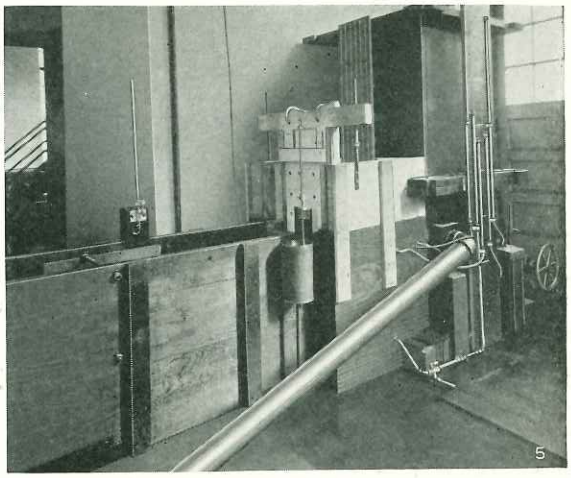


Figure 5

The group of test runners of model sizes, illustrated in Figure 6, gives some idea of the extensive experiments made in our laboratory, from which a vast amount of valuable data has been computed for perfecting turbines of commercial sizes.

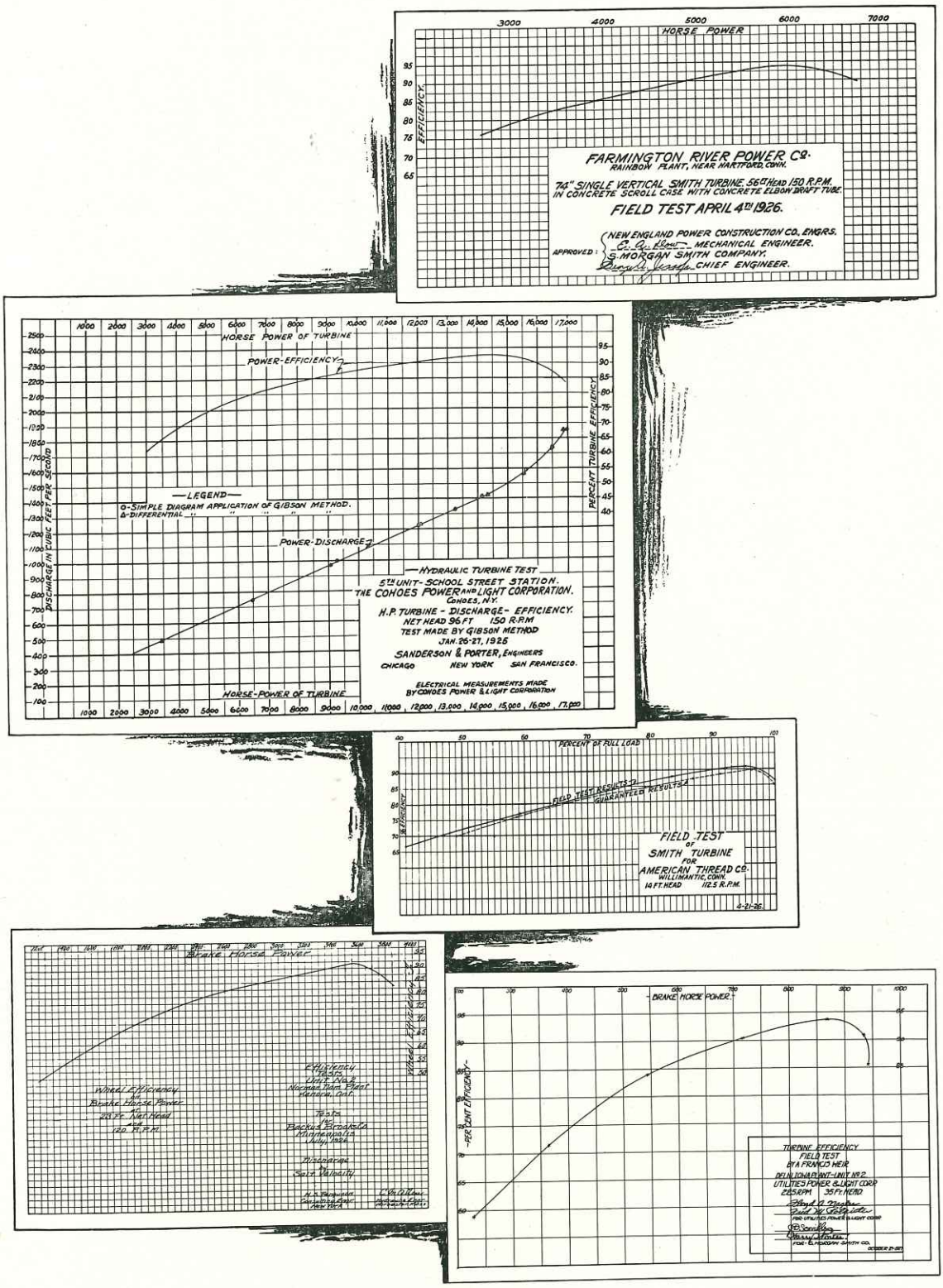
On the above basis the S. Morgan Smith Company is well qualified to make valuable recommendations to engineers and purchasers as to the most economical and efficient type of draft-tube, scroll case, etc., under the conditions proposed. Particularly true is this in connection with the reconstruction and modernizing of existing plants, where the scroll case or flume and draft-tube dimensions are very much limited in proportion to the increased power output demanded of the reconstructed plant.

A great many of our customers are taking advantage of our laboratory facilities by carrying out special tests of intakes and water passages which they are designing.

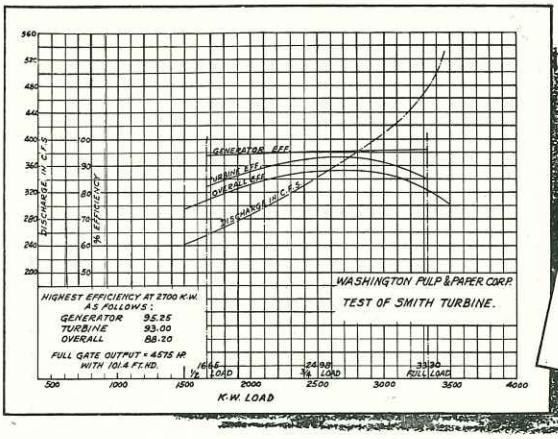
On the two following pages will be found a group of performance diagrams, showing the results of tests of Smith Turbines under actual operating conditions.

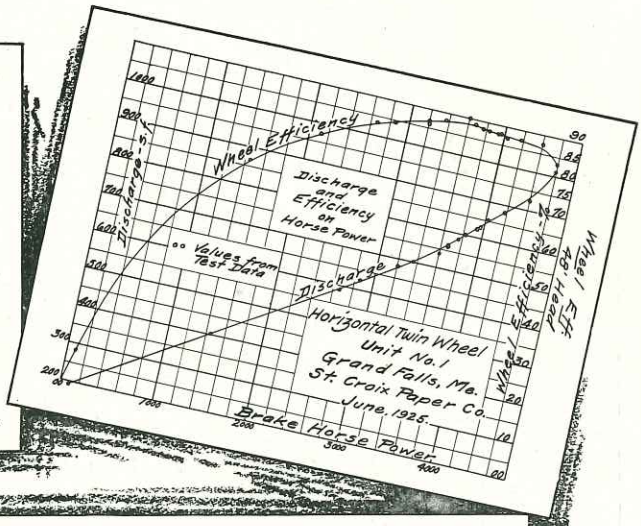
Figure 6

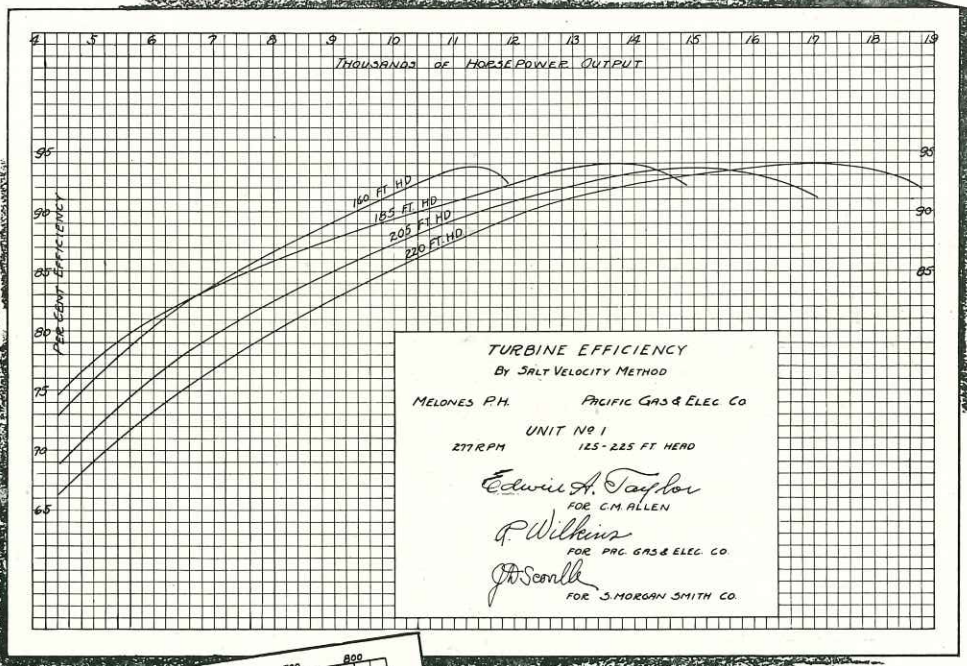
FIELD TESTS OF SMITH TURBINE INSTALLATIONS

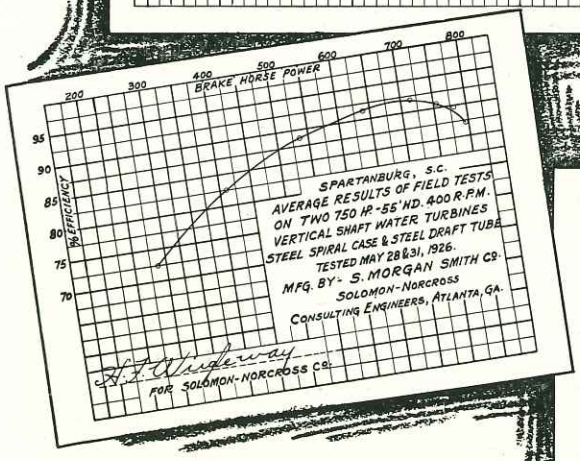


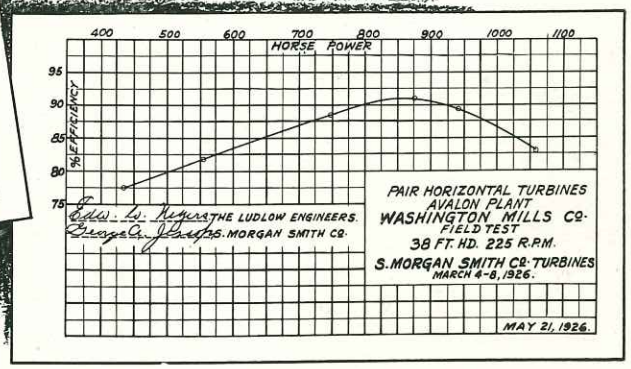
FIELD TESTS OF SMITH TURBINE INSTALLATIONS





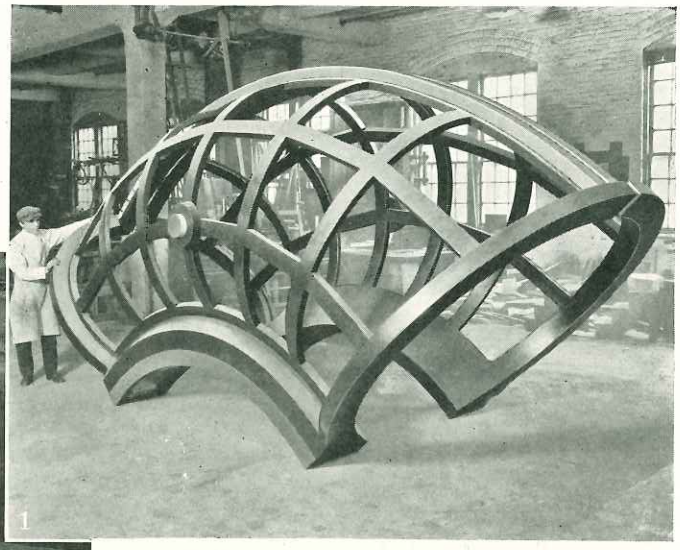



BRAKE HORSE POWER
% EFFICIENCY
SPARTANBURG, S.C.
AVERAGE RESULTS OF FIELD TESTS
ON TWO 750 HP - 55' HD. 400 R.P.M.
VERTICAL SHAFT WATER TURBINES
STEEL SPIRAL CASE & STEEL DRAFT TUBE
TESTED MAY 28 & 31, 1926.
MFG. BY - S. MORGAN SMITH CO.
SOLOMON-NORCROSS
CONSULTING ENGINEERS, ATLANTA, GA.
A.T. Wanderway
FOR SOLOMON-NORCROSS CO.



PLANT FACILITIES

Figure 1: Skeleton Pattern of Section of a Large Scroll Case



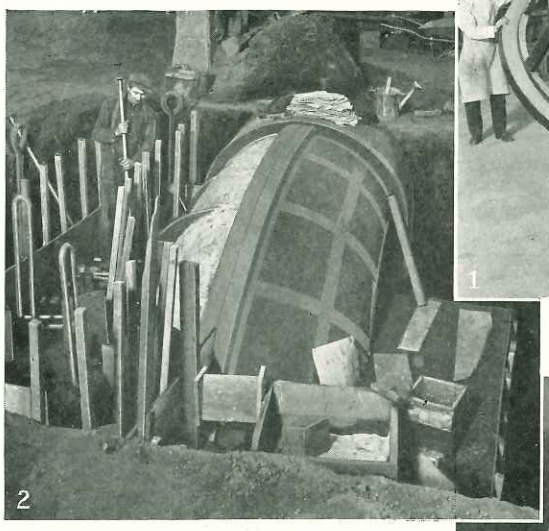


Figure 2: Foundry View Showing Scroll Pattern in the Sand

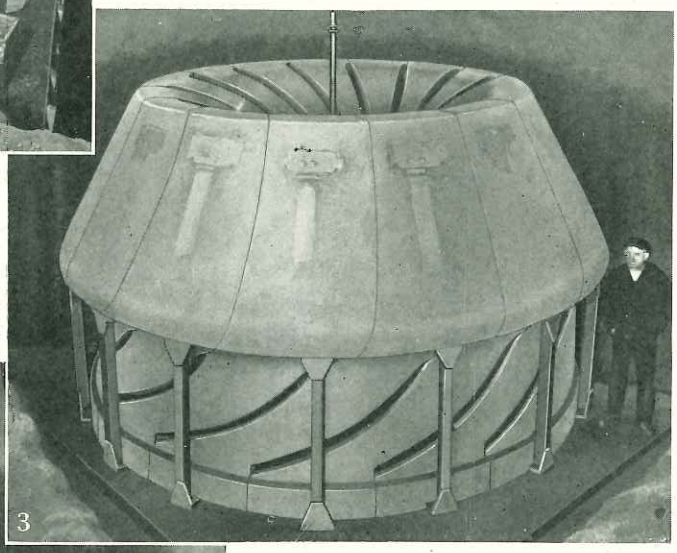


Figure 3: Dry Sand Cores for Large Solid Cast Turbine Runner Weighing Approximately 120,000 Pounds

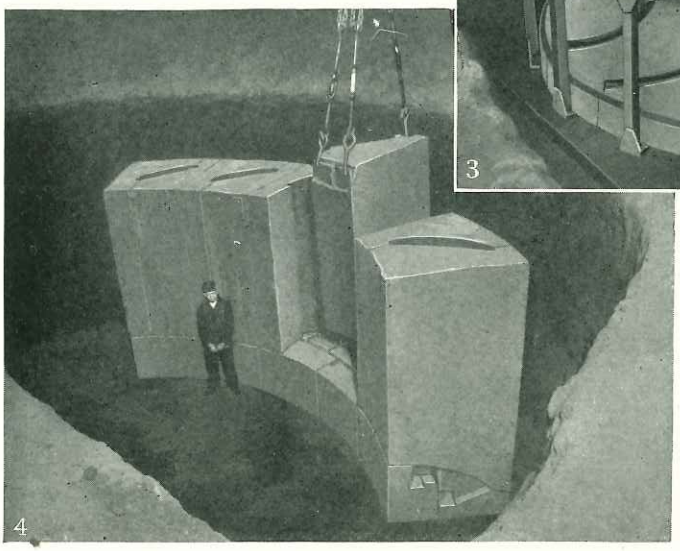
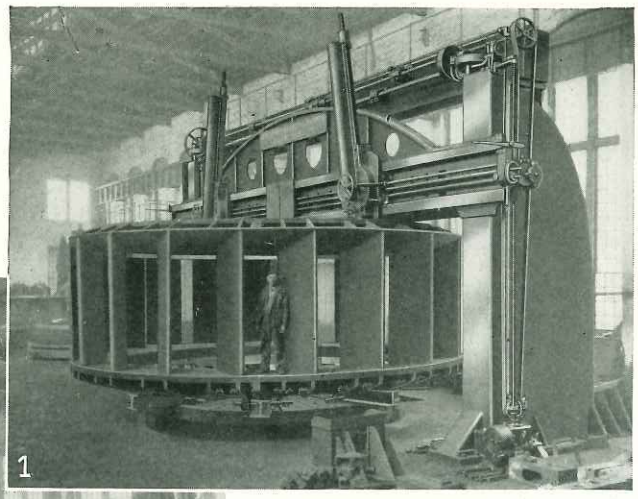


Figure 4: Setting Cores for Large Speed Ring

PLANT FACILITIES

Figure 1: Speed Ring on 36 Ft. Boring Mill



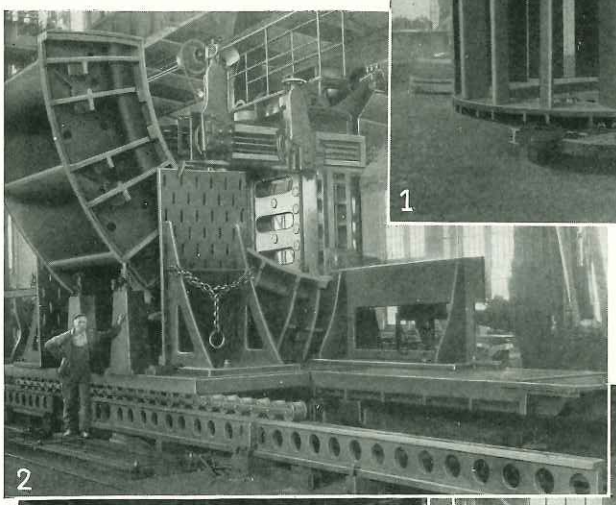


Figure 2: Section of Speed Ring on Open Side Planer

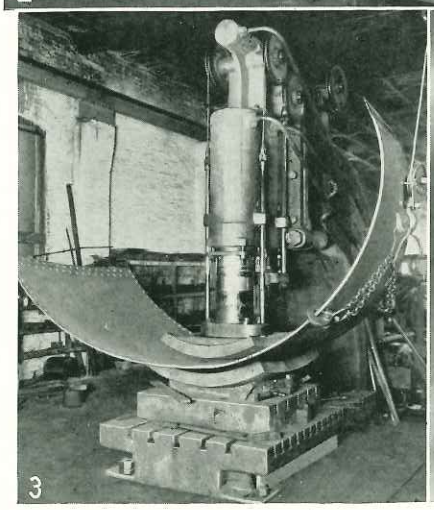


Figure 3: Hydraulic Press in Plate Steel Department

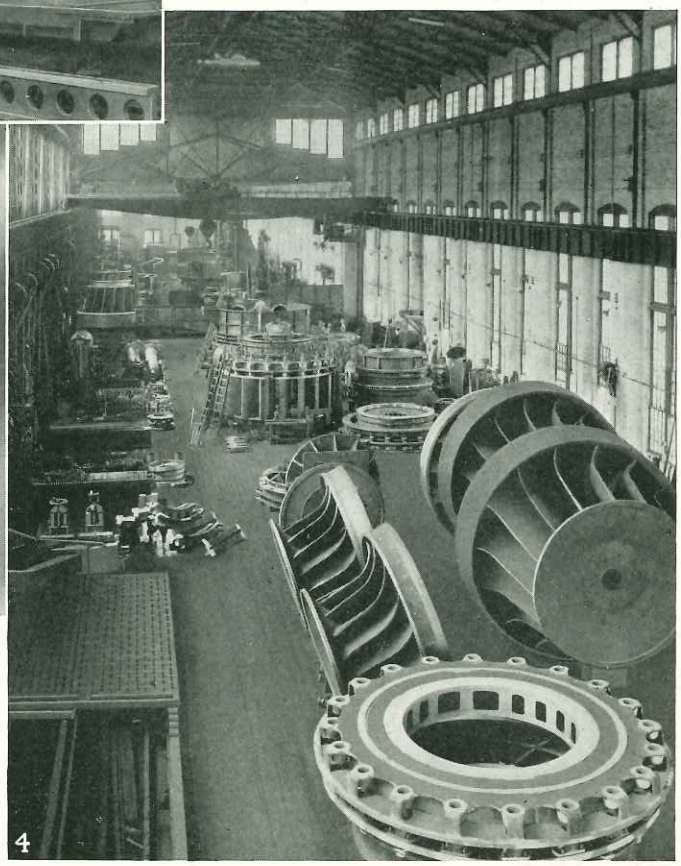
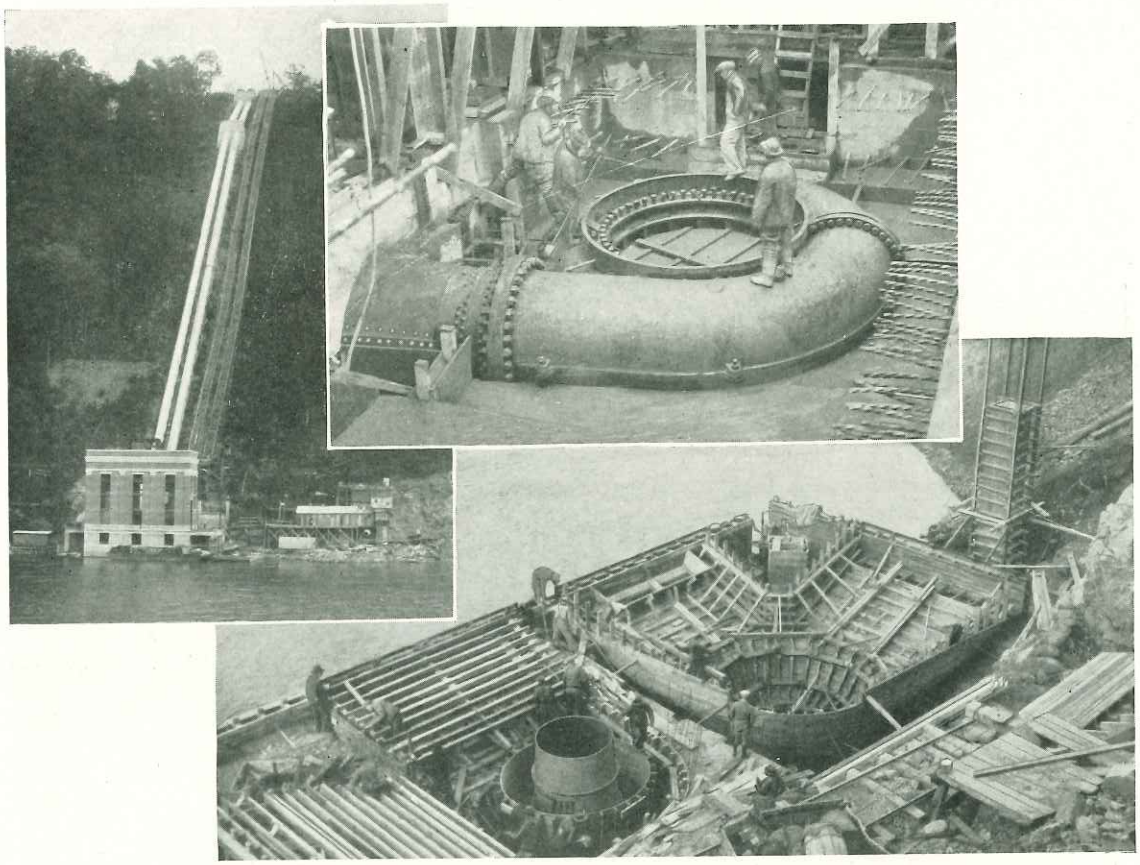


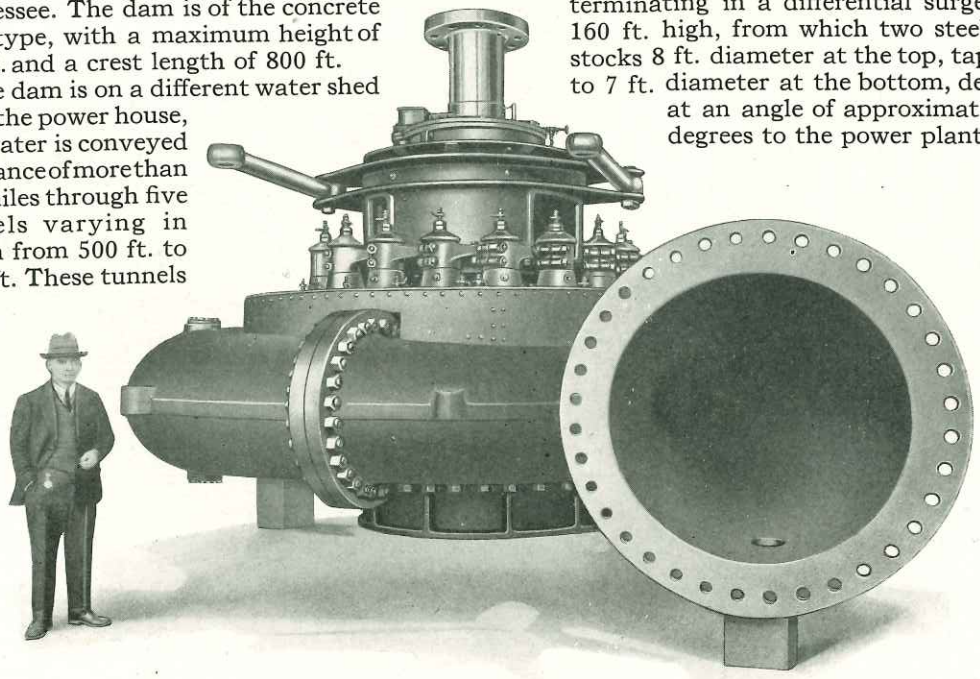
Figure 4: Assembly Floor No. 1 490 Ft. Long, 100 Ft. Wide

TALLASSEE POWER COMPANY—*Santeetlah Plant*

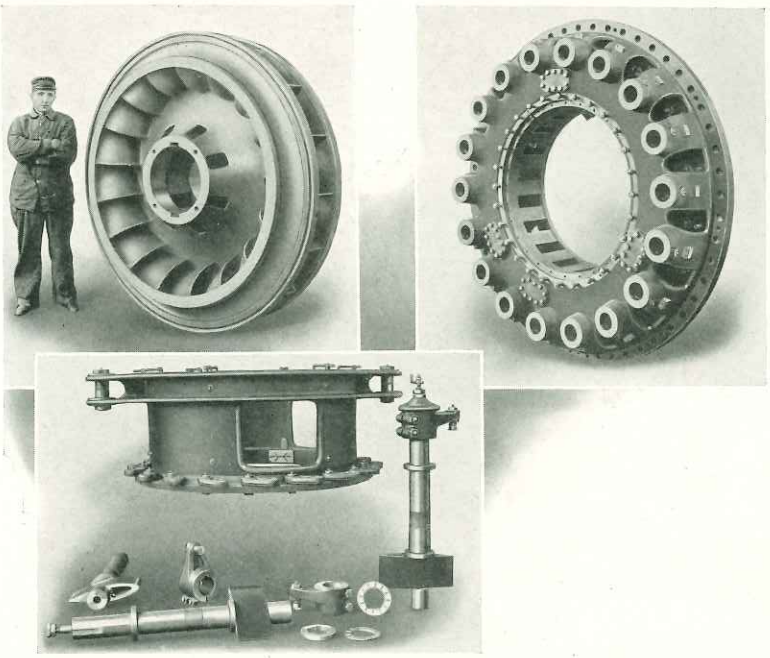


The Santeetlah Plant of the Tallassee Power Co., a subsidiary of the Aluminum Company of America, is located near Calderwood, Tennessee. The dam is of the concrete arch type, with a maximum height of 200 ft. and a crest length of 800 ft.

The dam is on a different water shed from the power house, and water is conveyed a distance of more than five miles through five tunnels varying in length from 500 ft. to 9175 ft. These tunnels are concrete lined, horse-shoe shape, with an inside area of 100 square feet, and are connected together by riveted steel pipe 11 ft. inside dia. terminating in a differential surge-tank 160 ft. high, from which two steel penstocks 8 ft. diameter at the top, tapering to 7 ft. diameter at the bottom, descend at an angle of approximately 30 degrees to the power plant.



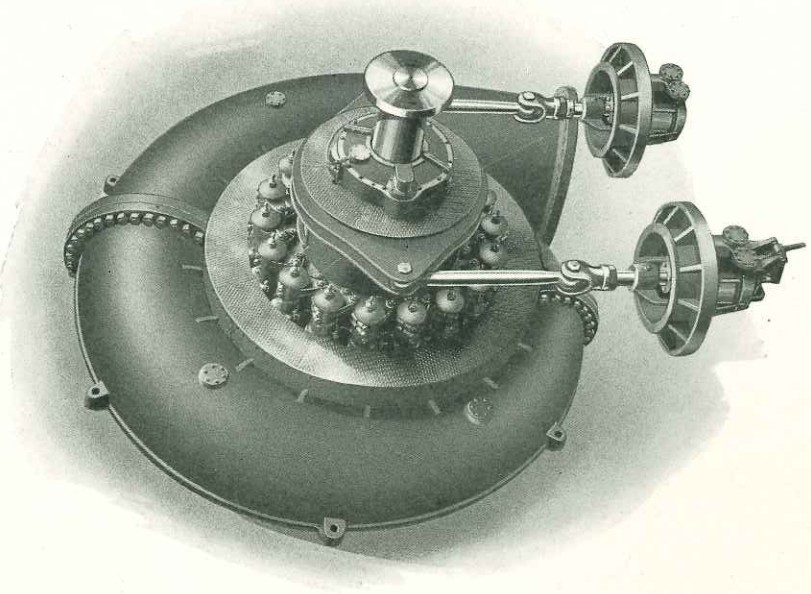
TALLASSEE POWER COMPANY—*Santeetlah Plant*



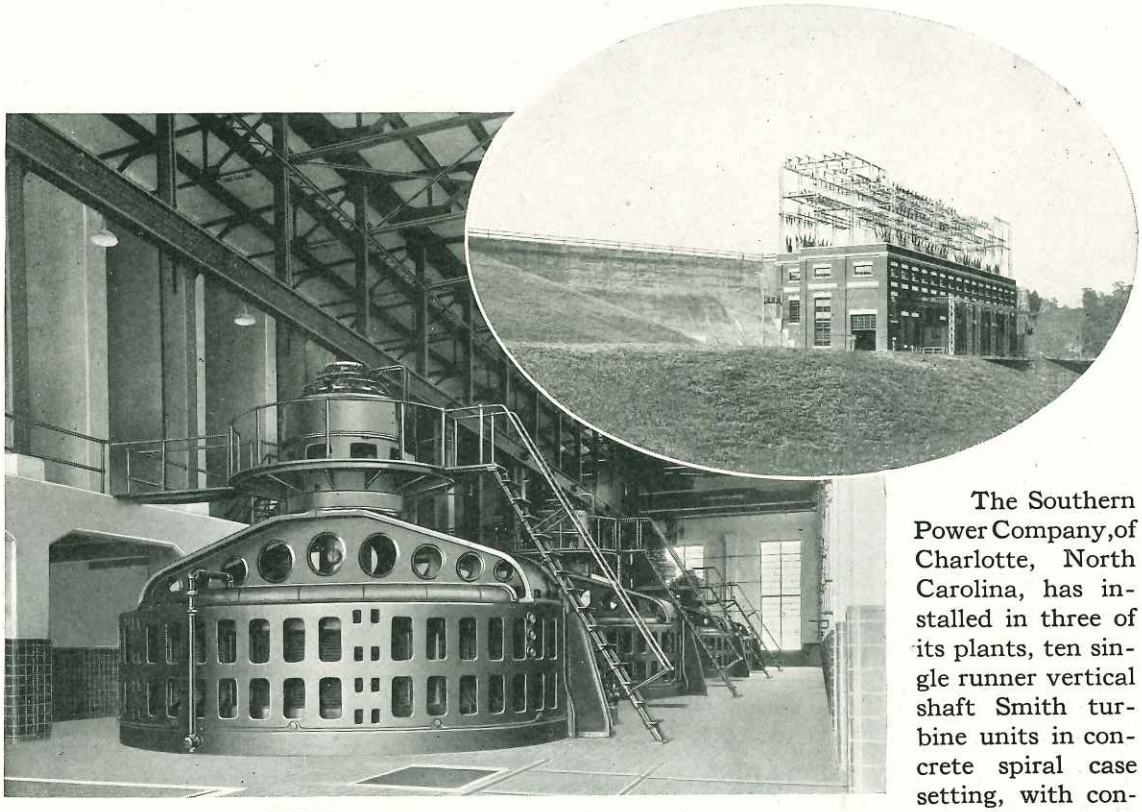
Each of the two units consists of a single vertical shaft Smith turbine mounted in a cast steel spiral case with a 4 ft. 6 in. diameter inlet. These units are of special design throughout for installation under heads varying from 540 ft. minimum to 660 ft. maximum. The rated capacity of each unit is 33,000 H. P. at a speed of 450 R. P. M. The turbine runners are of the solid cast type made of bronze, and the regulating gates are of steel with the stems cast integrally. S. Morgan Smith actuator governors and servo motors regulate the turbine gates. Two 8′-0″ Dow disc arm pivot valves are provided in the penstocks.

Shop views of the turbine runner, top plate, wicket gates and gate mechanism are shown; also a view of the assembled unit.

Two similar units are now under construction for the Waterville Dev. of the Carolina Power & Light Co. to operate under 755 ft. normal head, and 820 ft. maximum, developing 49,000 H. P. each.

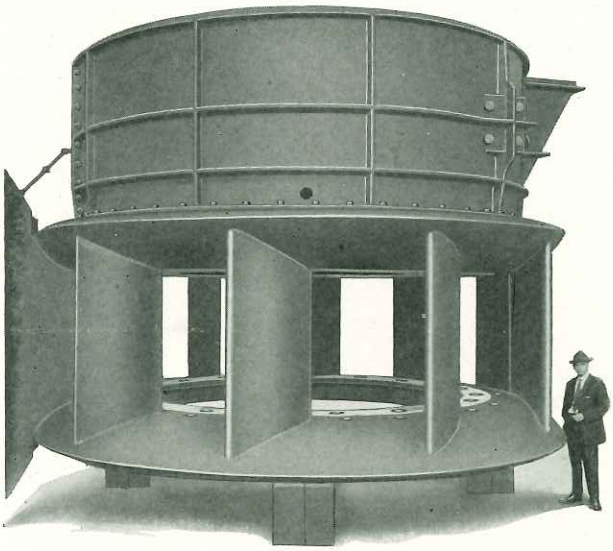


SOUTHERN POWER COMPANY—*Mountain Island Plant, Dearborn Plant, and Rhodhiss Plant*



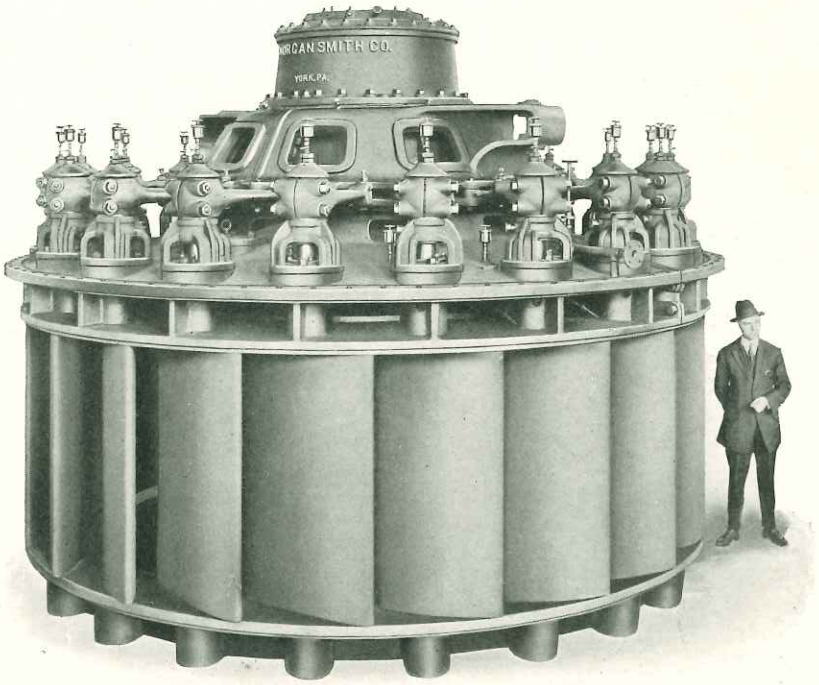
The Southern Power Company, of Charlotte, North Carolina, has installed in three of its plants, ten single runner vertical shaft Smith turbine units in concrete spiral case setting, with concrete elbow type draft-tubes. Four of these turbines are installed at the Mountain Island, N. C. plant, above illustrated, under a head varying from 76 to 83 feet, developing 22,700 Horse Power each, at a speed of 112.5 R. P. M.

The speed ring and pit liner are here illustrated, assembled prior to shipment in advance for building into the concrete spirals as shown in the construction view below.

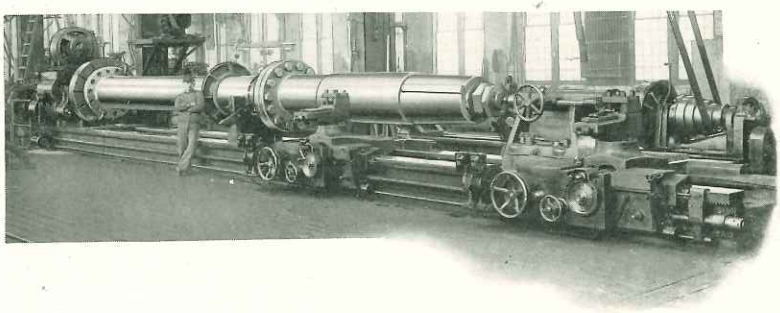


At the Dearborn Plant, Great Falls, S. C., are three of the same size units, operating under from 68.5 to 72 feet head, developing 12,000 Horse Power each, running 112.5 R. P. M. The Rhodhiss plant of the Western Carolina Power Co. is equipped with three similar units, under 62.5 feet head, developing 15,050 Horse Power each, at 100 R. P. M.

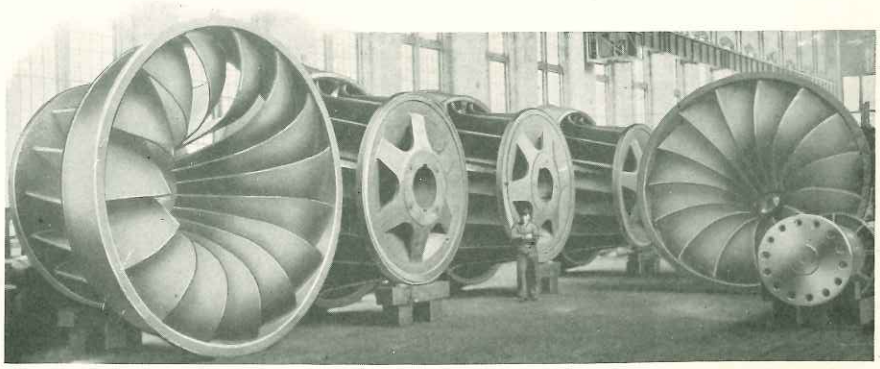
SOUTHERN POWER COMPANY—*Mountain Island Plant, Dearborn Plant, and Rhodhiss Plant*



Shop assembly of turbine parts, including top and bottom plates and regulating gates with complete gate operating mechanism, to insure proper fitting, and facilitate installation in the field.



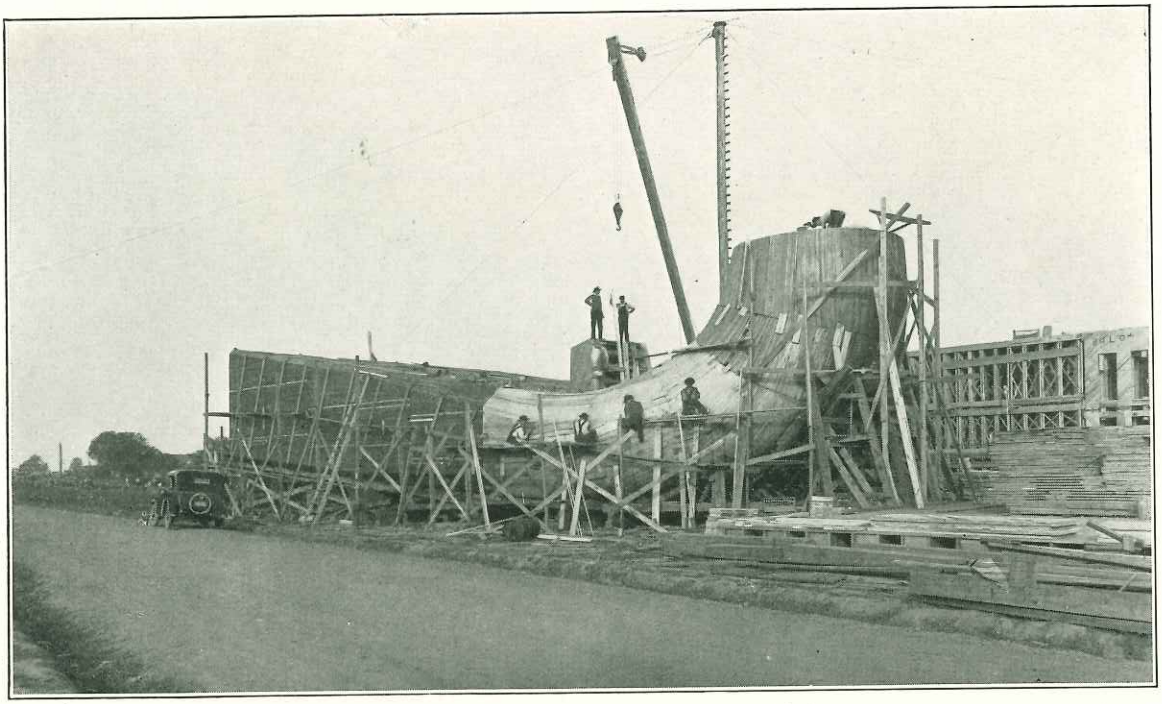
Runner shaft and extension shaft to generator in position in lathe for final cut and truing up. Shaft is 28″ in diameter with a total length of 35 feet.



A group of five of the ten turbine runners built under this contract. Each runner is a solid or continuous casting made in dry sand cores.

ALABAMA POWER COMPANY—*Jordan Dam*

SOUTHEASTERN ENGINEERING CO., *Engineers*



Form for Concrete Elbow-type Draft Tube

Jordan Dam, the largest hydro-electric development on the Alabama Power Co.'s system, is situated on the Coosa River near Elmore, Alabama, about 20 miles north of Montgomery. The dam is of the gravity type, arched in plan, and is 2,206 feet long, 103 feet high to the crest, and 125 feet high to the deck. Seventeen spillway gates, 18 by 30 feet, regulate the level of the pool. The power house is 105 feet high, 61 feet wide and 300 feet long. The initial installation consists of four Smith turbine units developing a total of 144,000 horsepower, the station being designed for an ultimate capacity of 216,000 horsepower.

After the contract for these turbines had been placed with us, the engineers of the Alabama Power Co. conducted thorough tests in our hydraulic laboratory of models of the intake passages, scroll case and draft tube in order to determine the design which would give the highest efficiency under the particular conditions of this development. These tests led to the selection of the scroll case and elbow type draft tube designs developed by our engineers in the past few years.

Each unit consists of a single runner vertical shaft turbine direct connected to a vertical generator with the thrust bearing mounted on the generator. The water is brought to the turbine through a concrete scroll case and discharged through a concrete elbow type draft tube. The runner, a solid semi-steel casting, is designed to develop a maximum of 36,700 H. P. at a speed of 100 R. P. M. under a net effective head of 90 feet. The water lubricated lignumvitae turbine guide bearing is of the fully adjustable type. Renewable steel wearing rings are provided on the runner and on the top and bottom plates at the water joints. Automatic air valves are supplied for admitting air to the draft tube when operating at small gate openings.

ALABAMA POWER COMPANY—*Jordan Dam*

SOUTHEASTERN ENGINEERING CO., *Engineers*

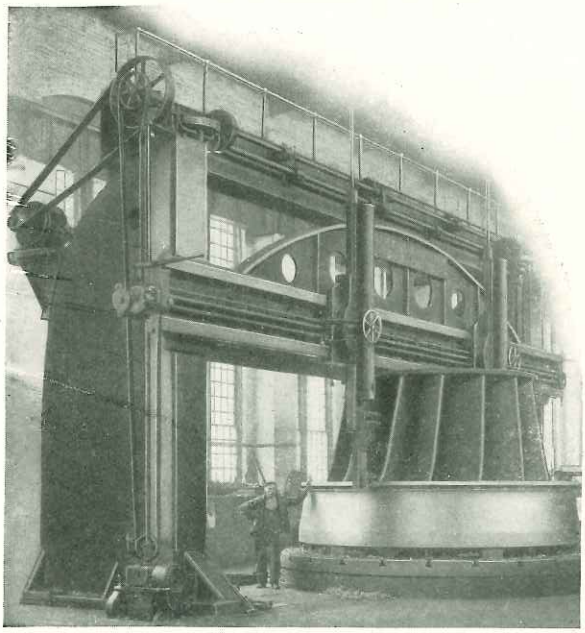


Figure 2

The accompanying views of the turbine parts during the machining processes in our factory show, above, one of the four 36,700 H. P. solid-cast semi-steel runners on a 36 ft. boring mill and, on the right, a portable electric tool in position for drilling and tapping bolt holes in one of the cast iron speed rings which weighed over 110,000 pounds.

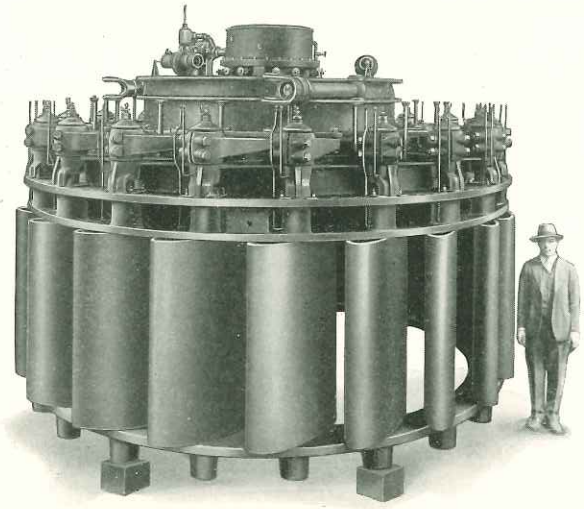


Figure 4

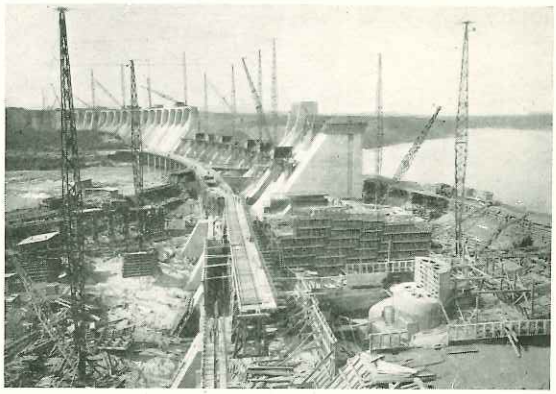


Figure 1

The above illustration shows the dam and power house during construction. The total length of the dam is 2,206 feet. Provision is made for the future installation of locks in the event that the river is made navigable.

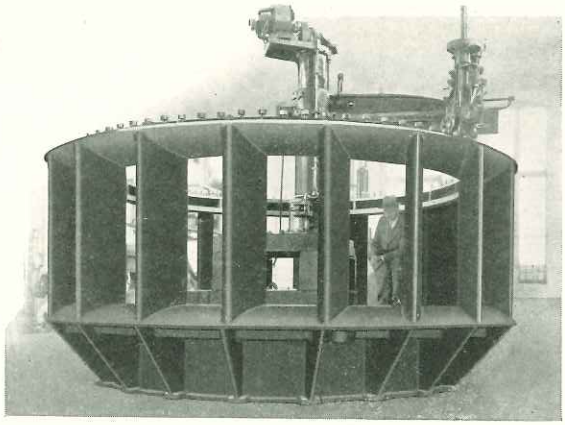
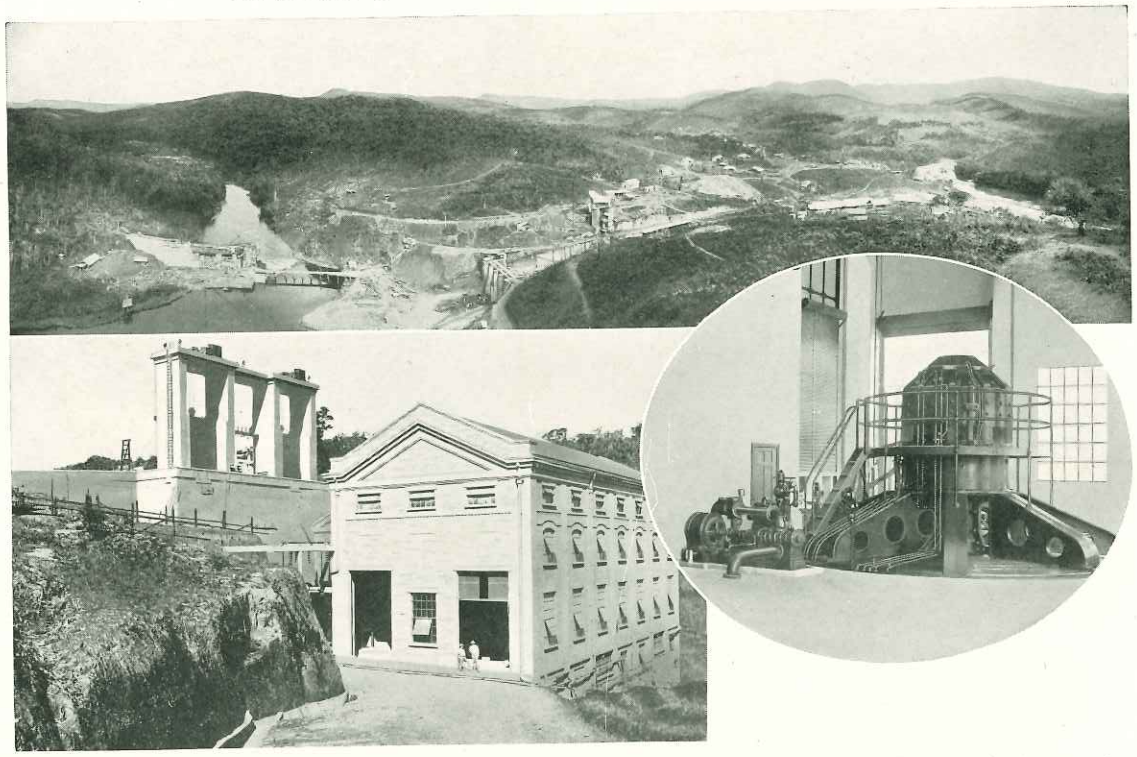


Figure 3

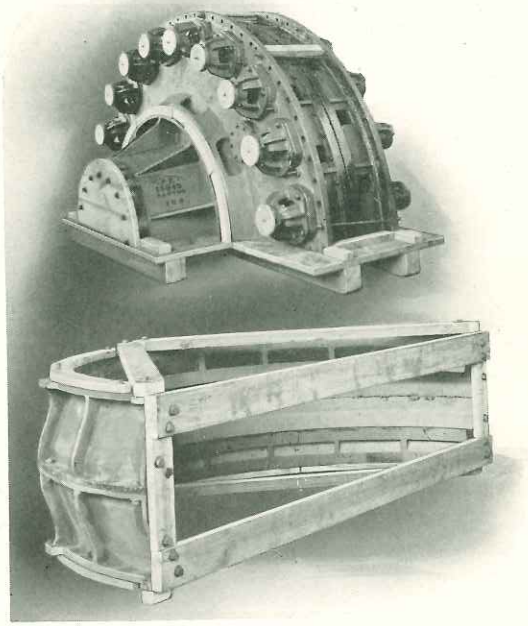
Figure 4 shows one of the single runner vertical shaft 36,700 H. P. Smith turbine units assembled without the speed ring before shipment from the factory. This view clearly shows the details of construction and the usual size of these turbines. The gate operating mechanism is shown complete except for the governor servo-motors which are mounted in the cast iron pit liner.

SAO PAULO TRAMWAY, LIGHT & POWER COMPANY—*Rasgao, Brazil*

CANADIAN & GENERAL FINANCE COMPANY, *Engineers*



The Sao Paulo Tramway, Light & Power Co.'s Rasgo Development in Brazil was constructed in record time despite construction difficulties and transportation obstacles. This plant is located on the River Tiete near Sao Paulo and the power is used for general public service purposes on the Sao Paulo transmission system. The illustrations above show the dam site during construction and the power house interior and exterior after completion.



Unusual skill and shop facilities were required to fabricate the hydraulic turbine equipment within the contract time limit. The two single runner vertical shaft turbines were delivered complete on the dock in New York four months from the date of signing the contract. These turbines were designed for installation in concrete scroll cases, each unit developing 12,760 H. P. at 128.6 R. P. M. under 65 feet operating head.

Top and Bottom Plates Packed for Export

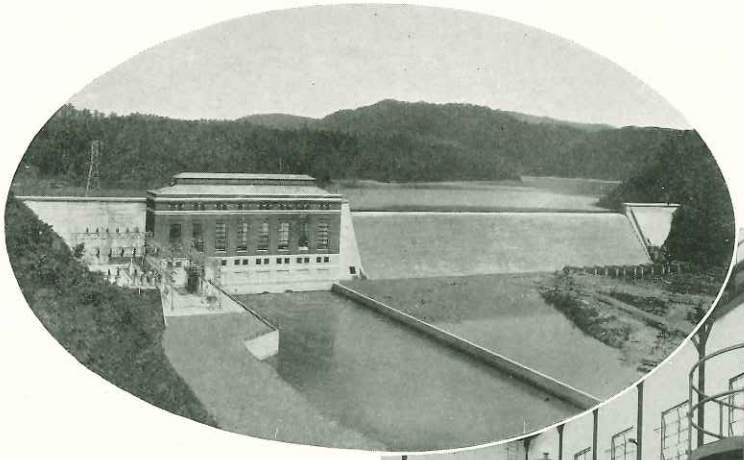
SAO PAULO TRAMWAY, LIGHT & POWER COMPANY—*Rasgao, Brazil*

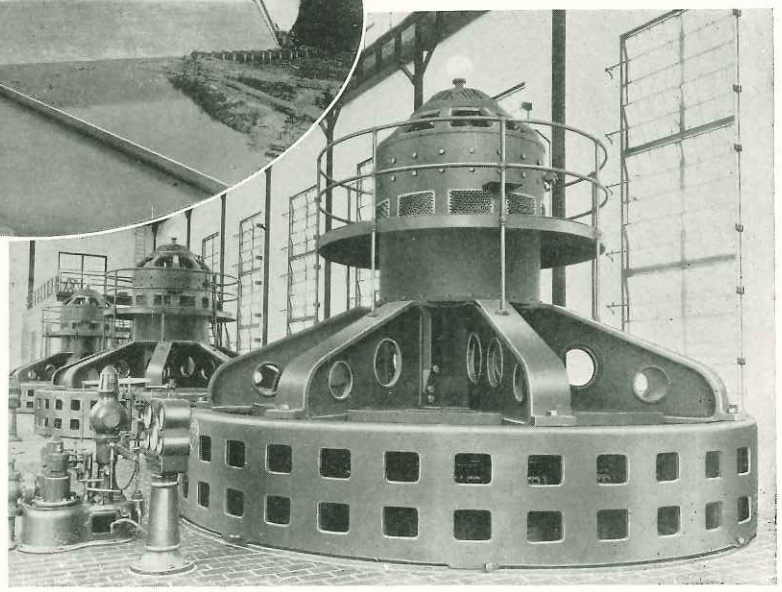
CANADIAN & GENERAL FINANCE COMPANY *Engineers*

Some idea of the difficulties met in handling the equipment in the field and installing it in the power house may be gained from the accompanying illustrations. This work was adequately supervised by S. Morgan Smith erecting engineers to whom much credit is given by the owners for the record time in which the field work was accomplished.

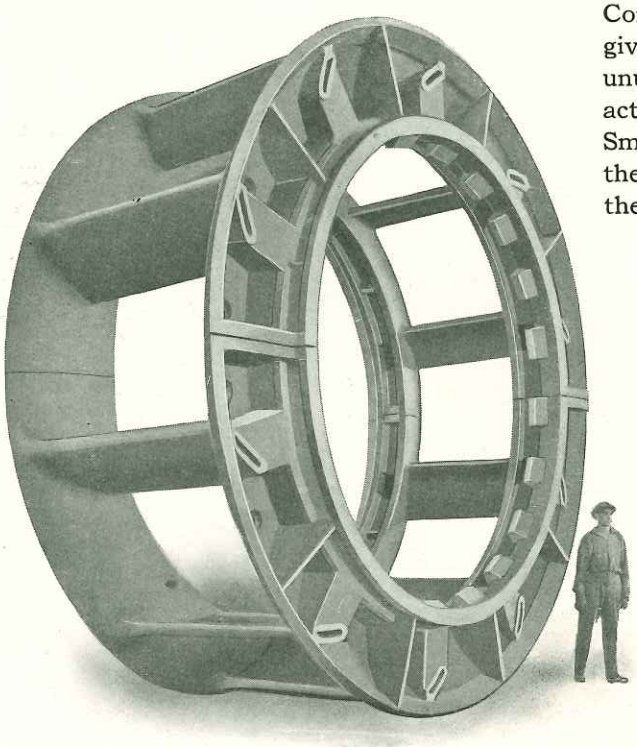
We now have under construction in our works one 40,000 H. P. unit for the Parahyba Plant of the Brazilian Hydro-Electric Co. which is operated under the same management as the Sao Paulo Co.

GEORGIA POWER COMPANY—*Yonah Development*

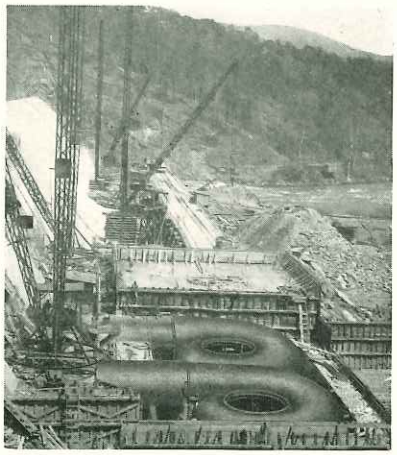




The hydraulic equipment for the Yonah Development of the Georgia Power Co. on the Tugalo River consists of three vertical shaft Smith turbines mounted in 15′–0″ inlet diameter steel spiral casings. Each unit develops 14,210 H. P. at 128.6 R. P. M. under 72 feet head.

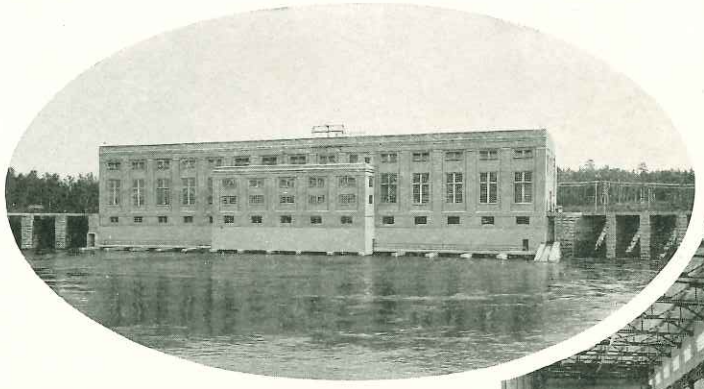


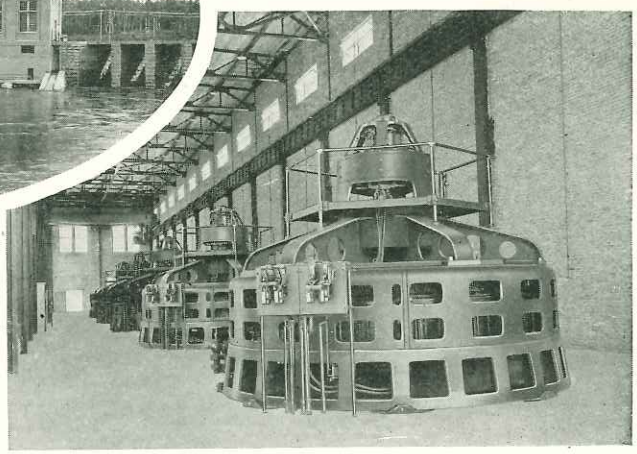
Construction and factory views here shown give a good idea of the class of work and its unusual size. Gibbs bearings and Smith actuator type governors are used. Other Smith equipment used in this plant includes the head gates, hoists and the steel liners for the intake and penstocks.

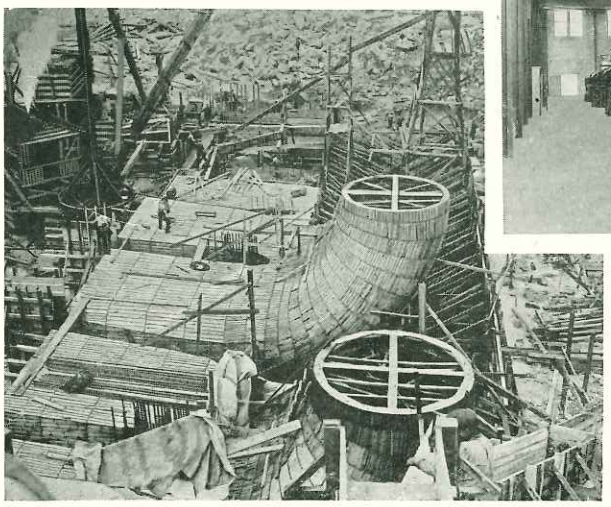


BACKUS BROOKS COMPANY—*Norman Dam Development*

HARDY S. FERGUSON, *Engineer*





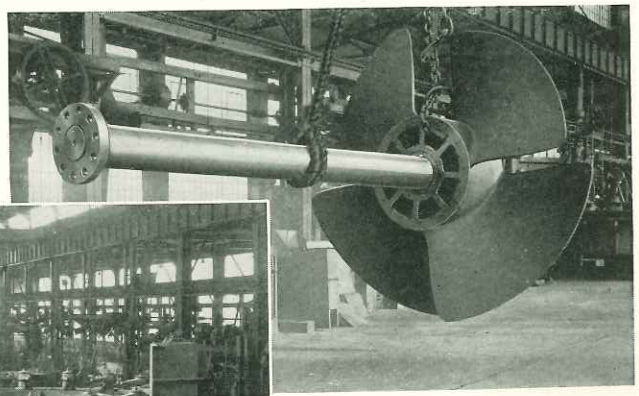


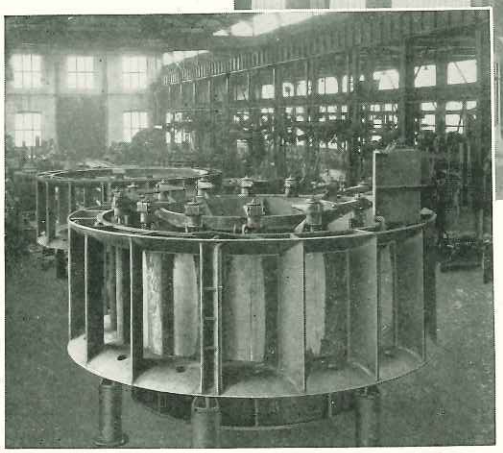
At the Norman Dam development of Backus Brooks Co. near Kenora, Ontario, five units of Smith High-speed type turbines are installed in concrete scroll cases with concrete elbow type draft tubes.

Each unit has a capacity of 3400 H. P. at 120 R. P. M. under 23 feet head. The very remarkable performance of this type of wheel is shown in report of field test appearing on page 10.

S. M. S. Actuator type governors are installed in connection with these turbines.

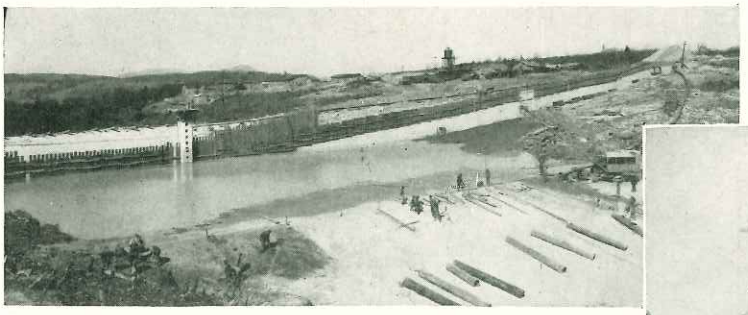
These turbines were built by our Associates, the S. Morgan Smith-Inglis Company in Toronto, Canada.



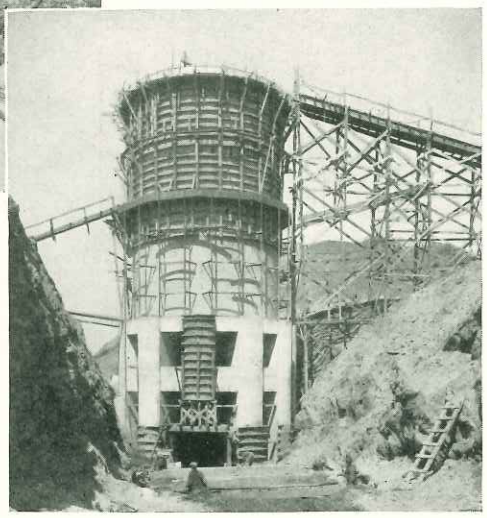


CONNECTICUT LIGHT & POWER COMPANY—*Rocky River Plant*

U. G. I. CONTRACTING CO., *Engineers*



General View of Dam during Construction

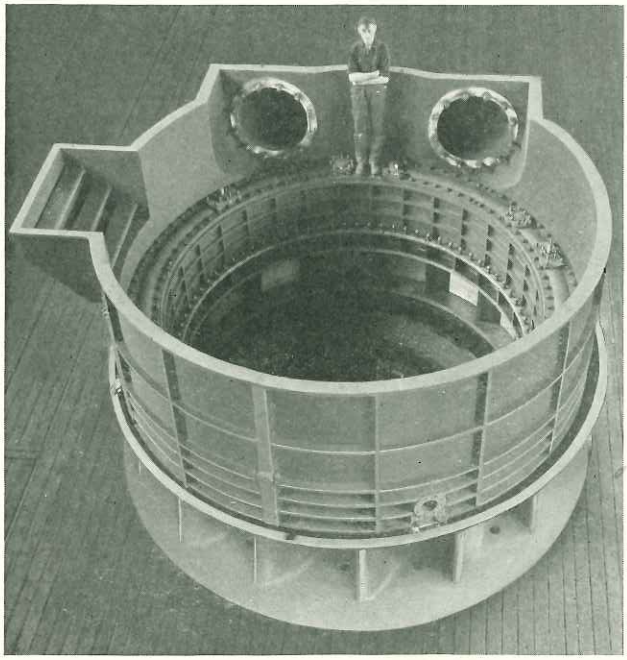


Intake Tower

This plant, built by the U. G. I. Contracting Co., is located on the Housatonic River near New Milford, Conn.

An earth-fill type dam, located about a mile from the plant diverts the water through 3,000 ft. of canal, 1,000 ft. of 15-foot diam. wood stave pipe, and 650 ft. of steel penstock, to the power house.

The turbine equipment consists of a single vertical shaft steel scroll case unit of 33,300 H. P. capacity at 200 R. P. M. under 212.5 ft. normal head.

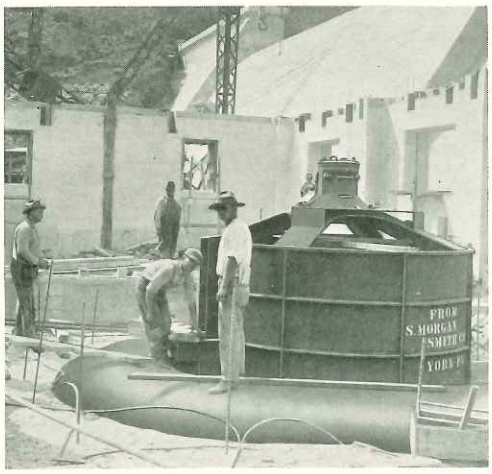


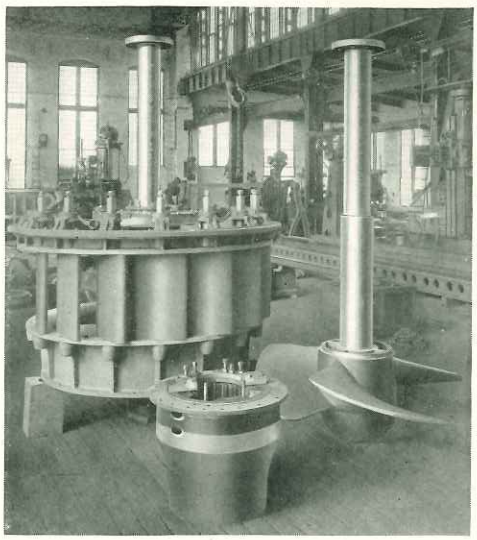
Speed Ring and Pit Liner Assembled in Shop

The outstanding feature of this development is the use of seasonal and night-time pumping to equalize the flow of the river. The reservoir for the plant is on a small water shed on the Rocky River, a tributary of the Housatonic. In the spring and at other times of high water in the Housatonic, water is pumped up into the reservoir, to be let out again at times of peak load or draught, when the flow in the Housatonic is low.

Two vertical shaft centrifugal pumps with direct connected motors, each rated at 112,500 gallons per minute against 240 ft. head are installed in the power house. These pumps discharge the water through the same penstock which supplies the turbine. A special cylinder gate is built into the turbine casing to shut off the flow to the turbine when water is being pumped into the storage reservoir.

GEORGIA POWER COMPANY—*Nacoochee Development*

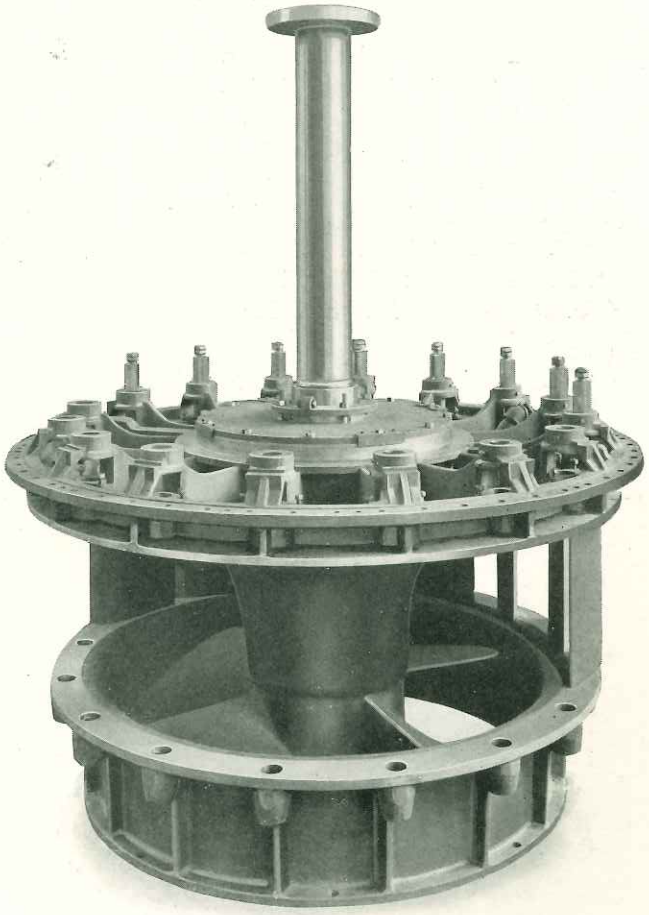




The Nacoochee Development of the Georgia Power Co. comprises an installation of two vertical shaft Smith turbines of the high-speed type. Each turbine is mounted in a 9′–0″ inlet diameter steel scroll case and develops 4,000 H. P. at 400 R. P. M. under 58 feet head. Gibbs oil-bath type thrust bearings support the weight of the rotating elements and the hydraulic thrust on the turbine runner and Smith gate shaft governors control the units.

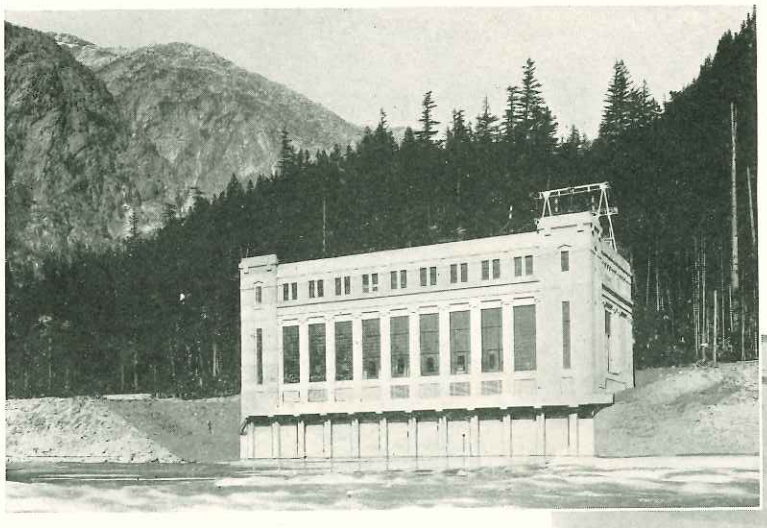
The construction view above shows the unit assembled in the power house with the scroll case partly imbedded in concrete and with the cast iron pit liner and the oil lubricated intermediate bearing in place.

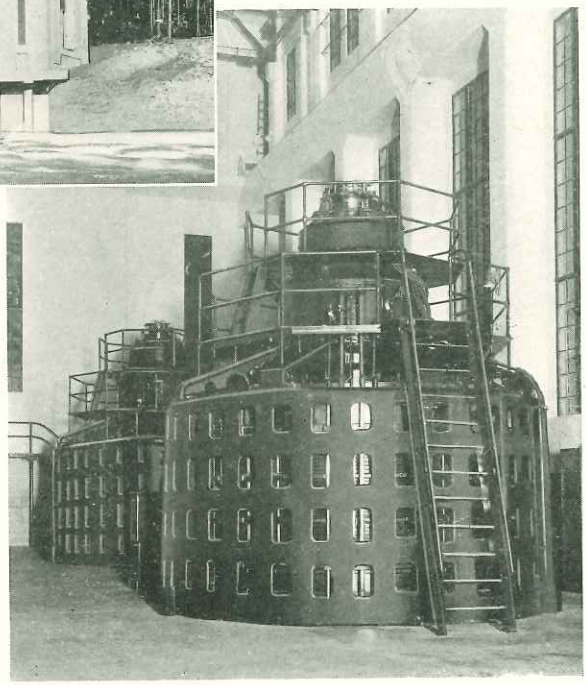
The two shop views show details of the construction of this type of unit, the one above showing the wheel case, lignum-vitae bearing and the runner on the shaft and the view on the right showing the wheel case with the speed ring and some of the wicket gates removed to show the runner in place.



CITY OF SEATTLE, WASHINGTON—*Skagit River "Gorge" Plant*

C. F. UHDEN, *Engineer*





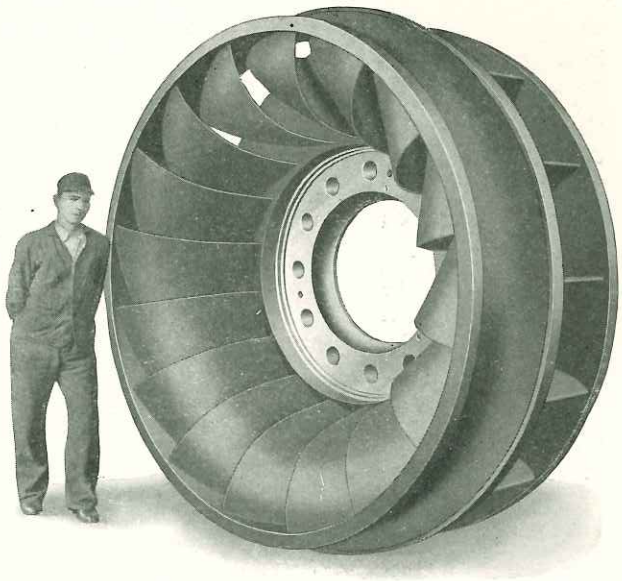
Electric power for Seattle, Washington, is supplied by the city owned and operated hydro-electric plant one hundred and five miles away at Gorge Creek on the Skagit River near Rockport. The initial installation of two turbines was made in 1923 and the third turbine was installed in 1928. All three units are Smith single vertical shaft turbines set in 84″ inlet diameter cast steel scroll casings. The rated capacity of each unit is 27,500 H. P. at 257 R. P. M. under 275 feet head but the turbines are designed to develop 38,800 H. P. at 375 feet head, which will be the effective head at this plant when the dam is finally completed.

The above views show the exterior and the interior of the power house and the illustrations on the left show the dam site in the gorge and the rapids on the Skagit River with snow covered mountains in the background.

CITY OF SEATTLE, WASHINGTON—*Skagit River "Gorge" Plant*

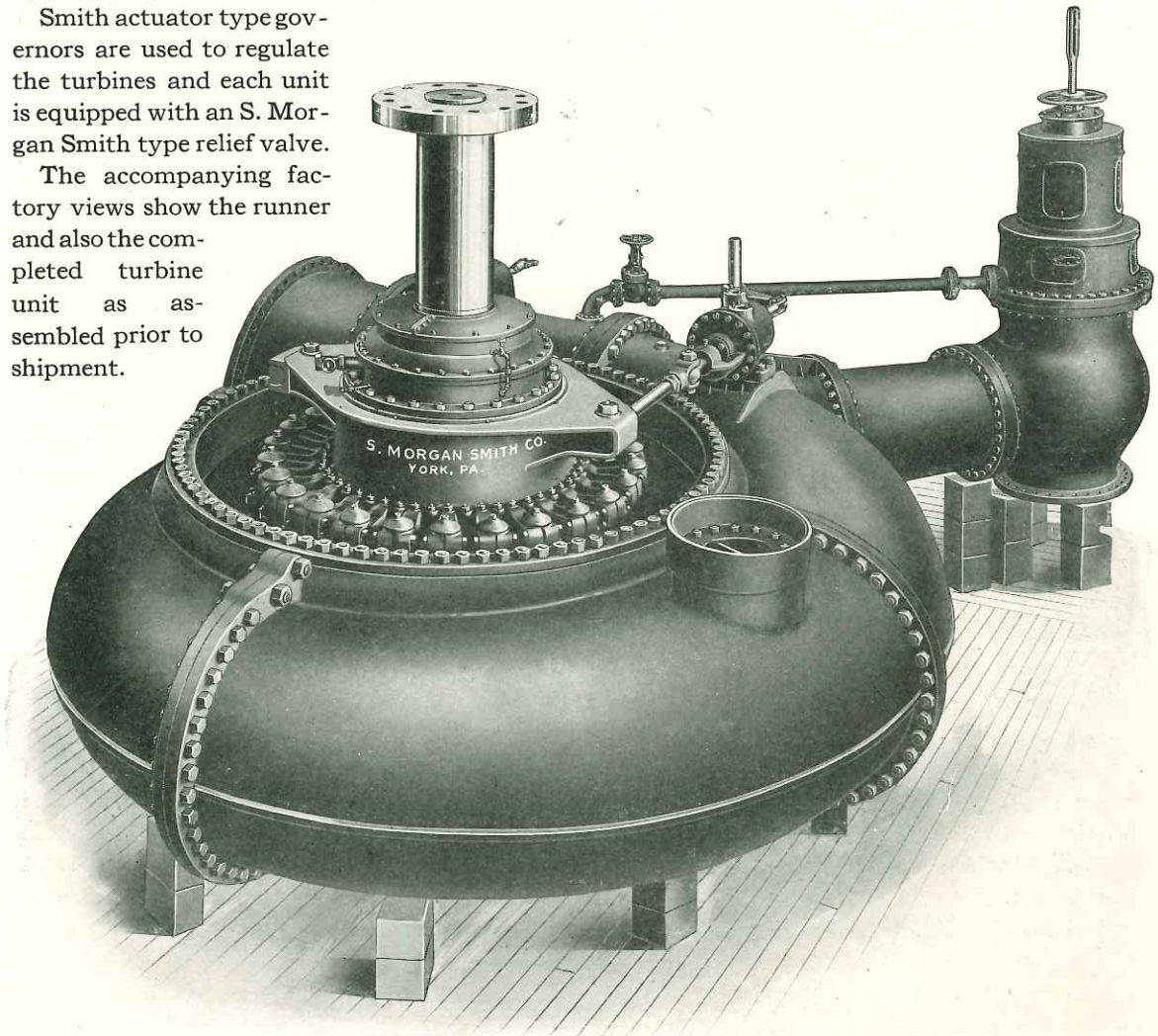
C. F. UHDEN, *Engineer*

A temporary diversion dam near the mouth of Gorge Creek turns the water through a tunnel to the power house. This tunnel is of horse-shoe section with a finished area of 300 square feet and a length of about 11,000 feet to the surge tank. Connection is made from the surge tank to the turbines through a short tunnel and 10′ 0″ diameter steel penstocks. Ultimately it is planned to build a masonary dam below the present temporary crib dam which will increase the head to 375 feet and provide some storage capacity for the plant. When this dam is completed the capacity of the units will be increased to 38,800 H. P. merely by changing the runners.



Smith actuator type governors are used to regulate the turbines and each unit is equipped with an S. Morgan Smith type relief valve.

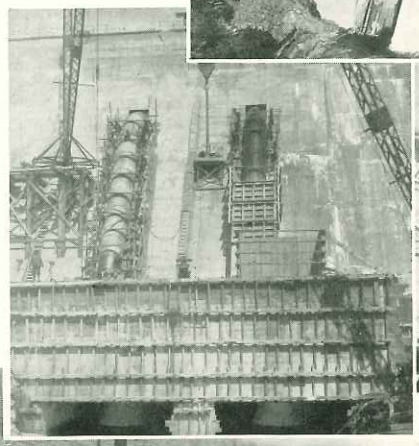
The accompanying factory views show the runner and also the completed turbine unit as assembled prior to shipment.

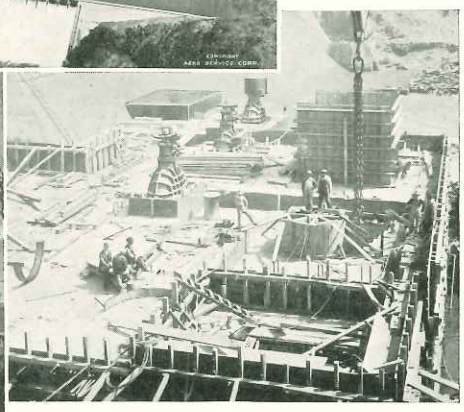


GEORGIA POWER COMPANY—*Burton Plant*

Burton Dam, the uppermost plant in the chain of developments of the Georgia Power Co. on the Tallulah and Tugalo Rivers stores 4,647,000,000 cubic feet of water for use in the series of six developments which utilize the entire head of 1,199 feet between the surface of Lake Burton and the tail race at Yonah, the lowest development.

Figure 1
Aeroplane View of Burton Dam





Figures 2 & 3

Construction views of the Burton Power House

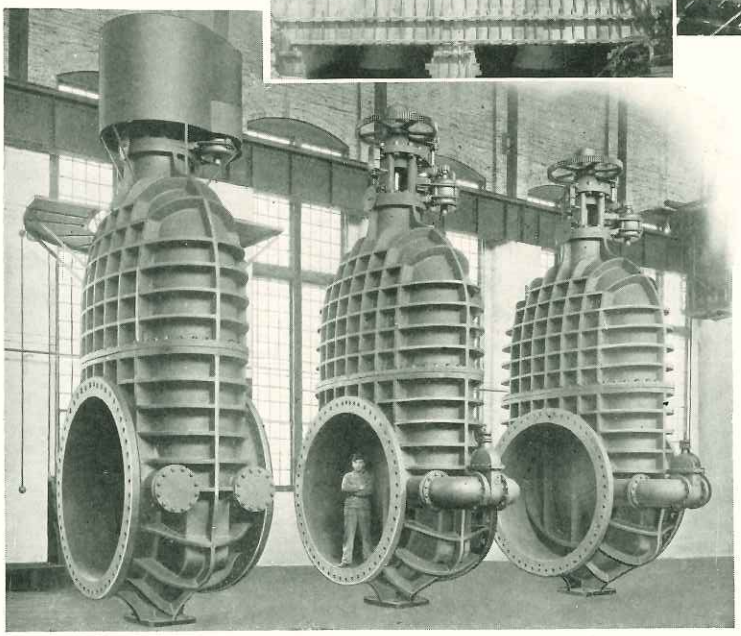


Figure 4

Shop view of the three 84″ motor operated gate valves supplied by us for this development. Two of these valves are placed in the penstocks to the turbines and the third is used as a by-pass valve operating under free discharge conditions

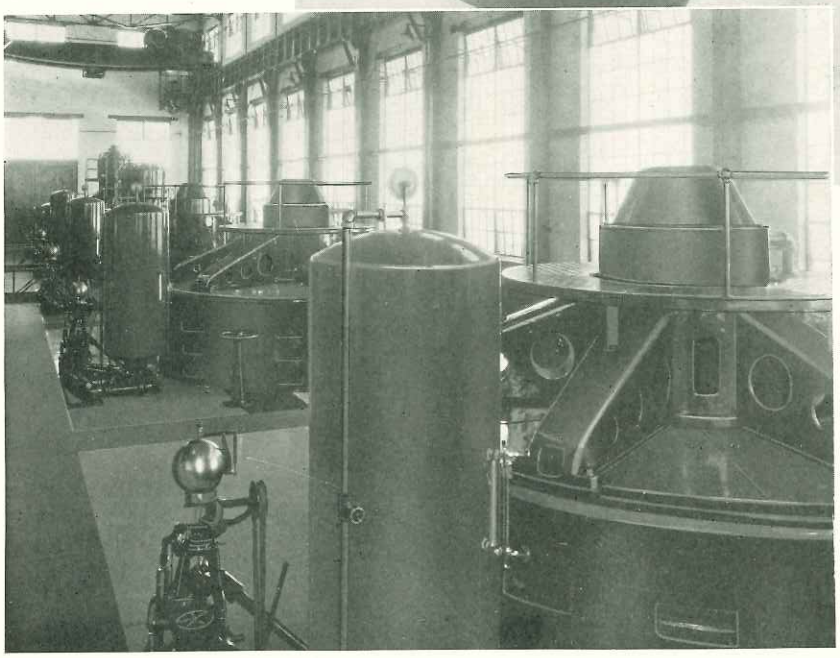
Due to the variations in head under which this plant operates, unusual characteristics were required in the turbines. The head varies from 116 feet as a maximum to 50 feet as the minimum during low water periods.

Two single runner vertical shaft Smith turbines, mounted in 7 ft. inlet diameter steel spiral casings are installed, the rated capacity of each unit being 6,000 H. P. at 110 feet head, the operating speed being 225 R. P. M. over the entire range of over 100% in head. Smith actuator governors control the units. The penstocks, intake gates, hoists and the system of moveable flashboards on the dam crest together with their hoists are of our manufacture.

COHOES POWER AND LIGHT CORPORATION—*Cohoes, N. Y.*

SANDERSON & PORTER, *Engineers*

View of the School Station of the Cohoes Power and Light Corporation on the Mohawk River



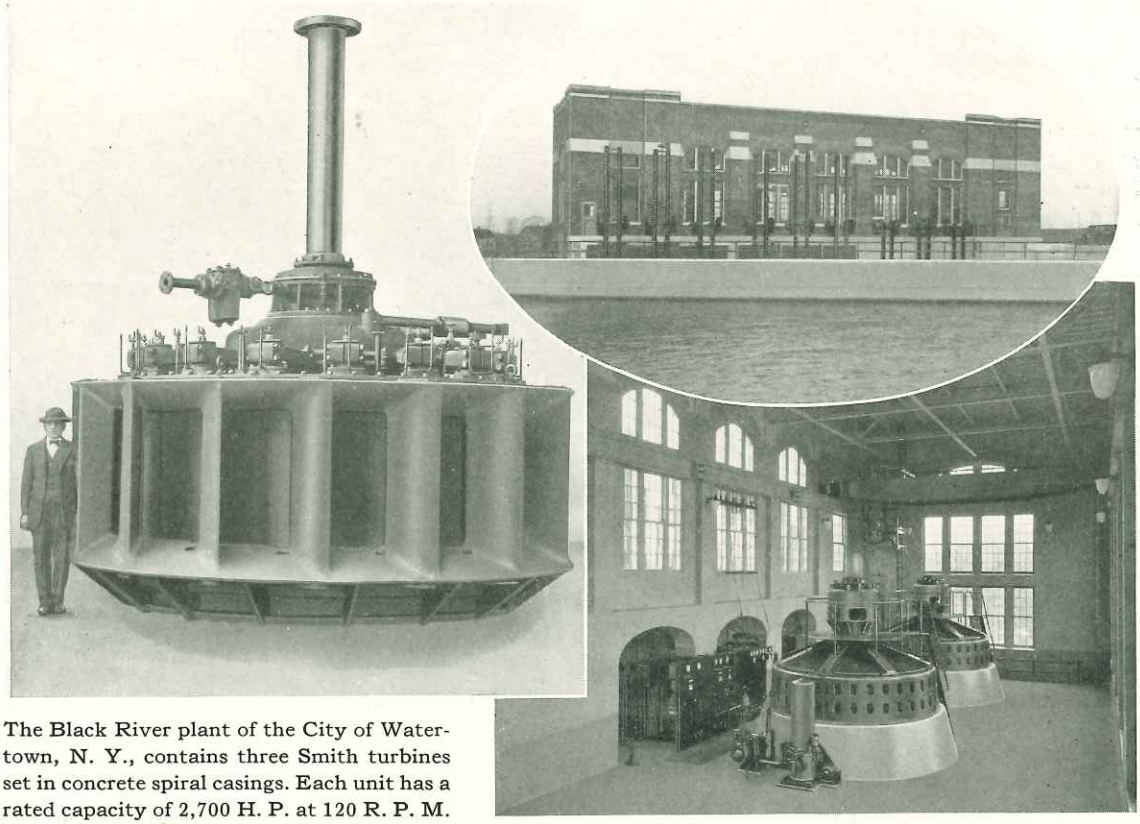
An Interior View of the School Street Station Showing the Completed Installations

The Cohoes Power & Light Corp. of Cohoes, New York, when they installed the fifth unit in their School Street Station, faced the problem of developing the maximum capacity possible in the remaining pit which was originally designed for 10,000 H. P.

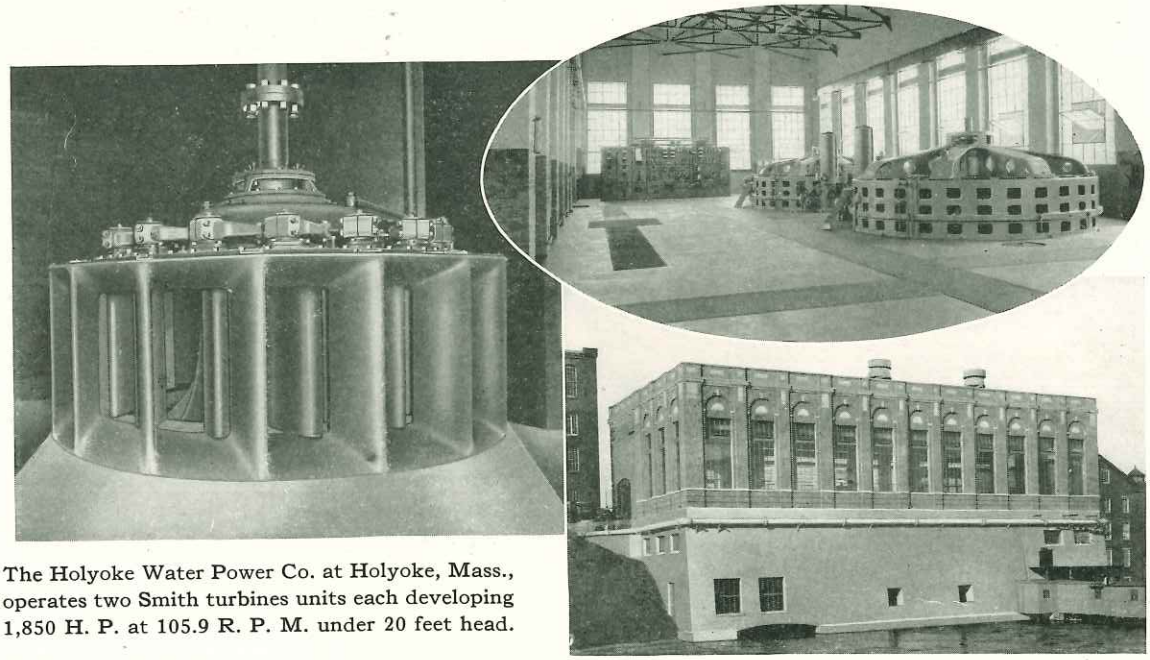
Extensive tests of model size turbines and draft tubes were made in our Testing Laboratory to ascertain the possibilities that could be relied upon. These experiments resulted in the installation of a Smith turbine in a steel spiral case, having an inlet opening 11′–6″ diameter and discharging through an elbow draft tube of special design.

Field tests showed a maximum capacity of 16,950 H. P. under 96 feet head at a speed of 150 R. P. M., which under the circumstances is considered a most remarkable performance, both in efficiency and in power developed. See Field Test Curve on Page 10.

CITY OF WATERTOWN, N. Y.—*Black River Plant*
HOLYOKE WATER POWER COMPANY—*Holyoke, Mass.*



The Black River plant of the City of Watertown, N. Y., contains three Smith turbines set in concrete spiral casings. Each unit has a rated capacity of 2,700 H. P. at 120 R. P. M. under 26 feet head.



The Holyoke Water Power Co. at Holyoke, Mass., operates two Smith turbines units each developing 1,850 H. P. at 105.9 R. P. M. under 20 feet head.

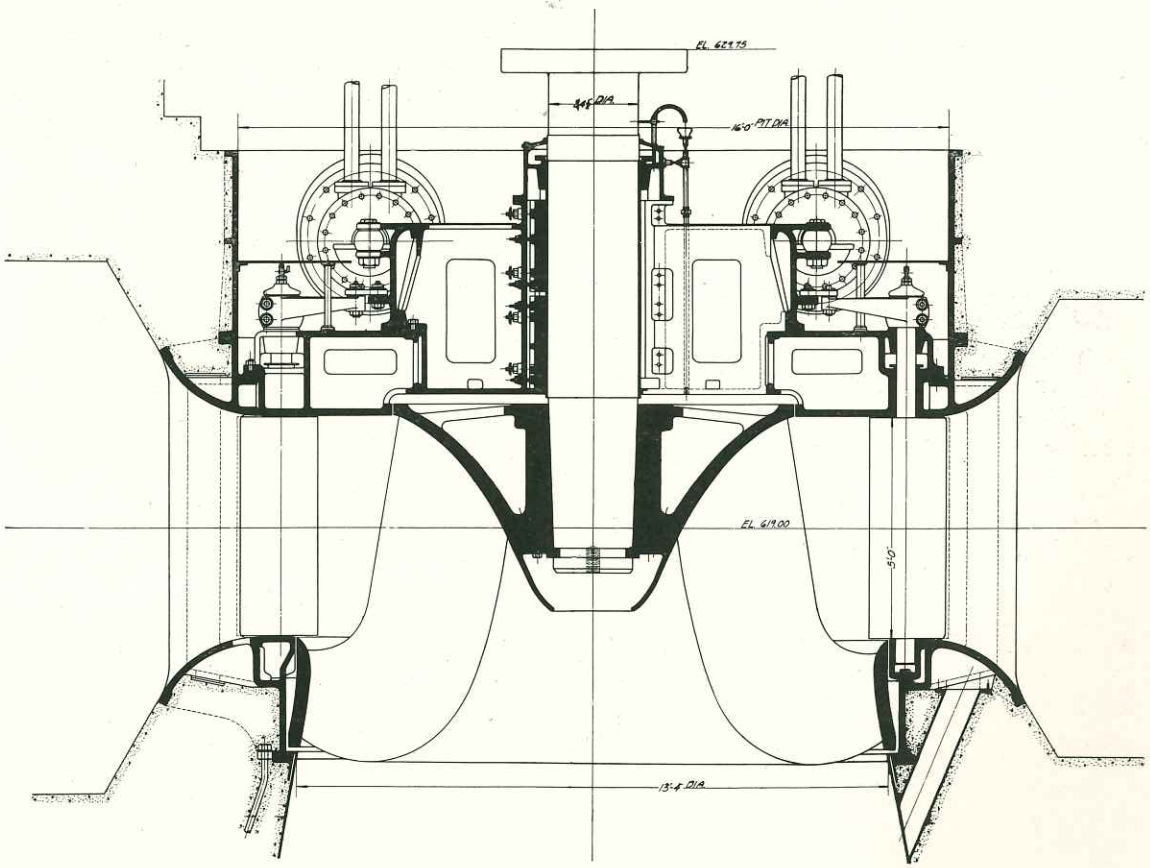
HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

Camp Alexander Development

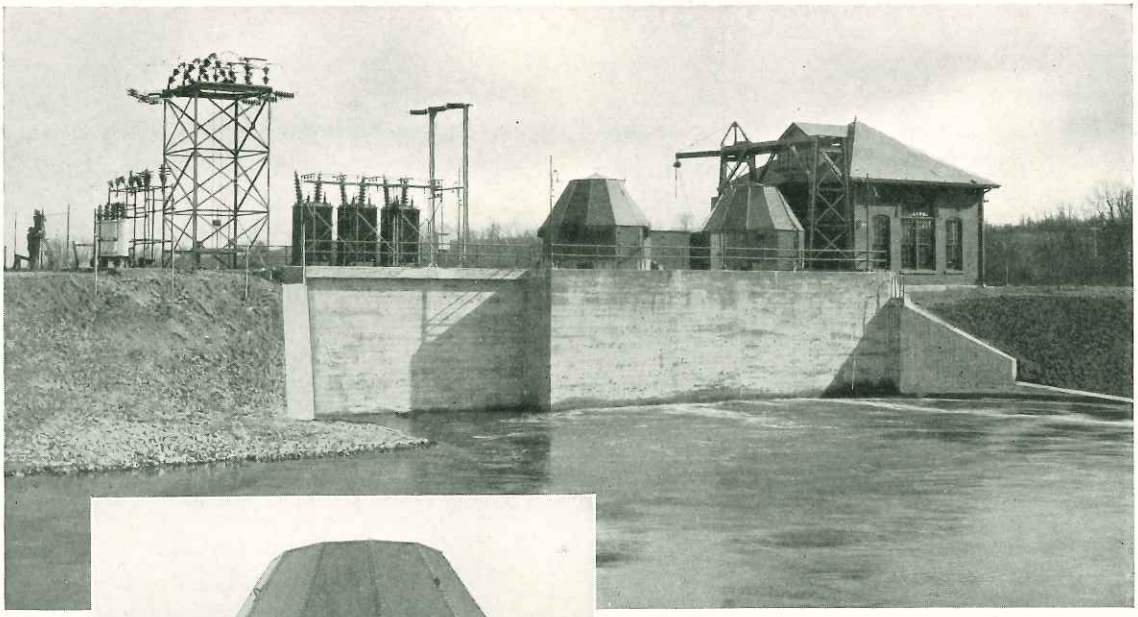
The hydraulic equipment for the Camp Alexander development on the Nipigon River about 70 miles east of Port Arthur, Ontario, consists of three single runner vertical shaft turbines direct connected to vertical generators with the thrust bearings mounted on the generators. The turbines are set in concrete spiral flumes and discharge through concrete elbow draft tubes. The lignum-vitae turbine guide bearings are fully adjustable. Each unit will develop 18,000 H. P. at 100 R. P. M. when operating under 64 feet head. Details of the turbine construction are shown in the cross-sectional view below.

These burbines were built in Toronto, Canada, by our associates, the S. Morgan Smith-Inglis Co., Ltd.

The Smith-Inglis Co. now has under construction a number of large turbines, among which are four units for the Chute-a-Caron development of the Alcoa Power Co. on the Saguenay River, these units being designed to develop 75,600 H. P. each at 120 R. P. M. under 165 feet effective head; and three units for the High Falls development of the James MacLaren Paper Co., Ltd. on the Lievre River which will develop 30,000 H. P. each at 180 R. P. M. under 180 feet head. These turbines are all of the single runner vertical shaft type and will be installed in steel spiral casings and will discharge through concrete elbow type draft tubes. The Smith-Inglis Co. is also building several fixed and adjustable blade type high speed turbines.

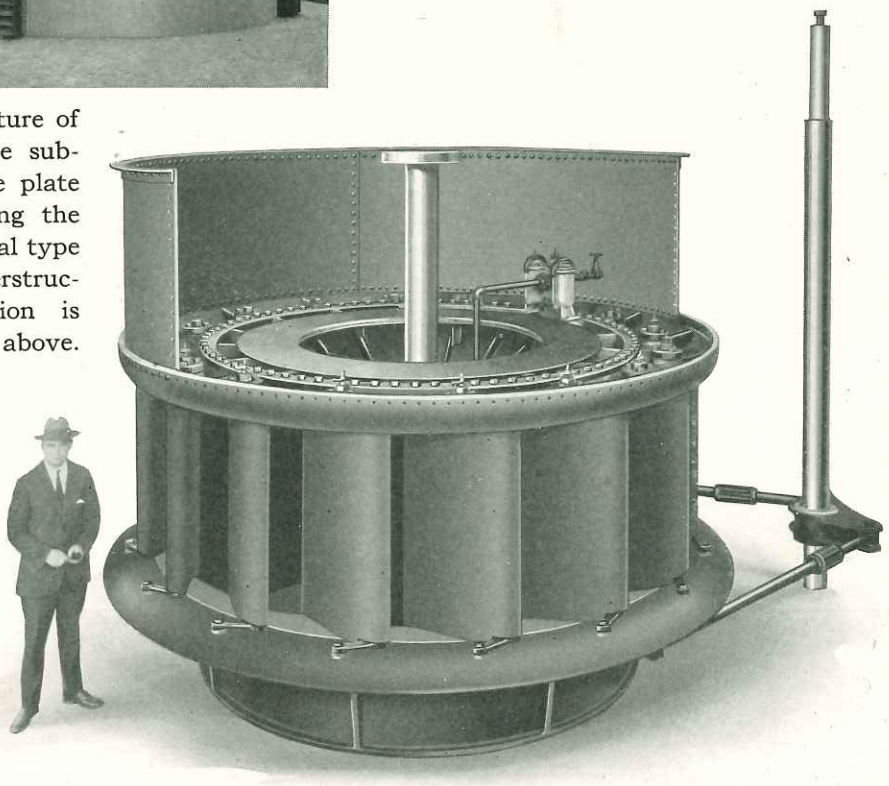


CONSUMERS POWER COMPANY—*Otsego Plant*



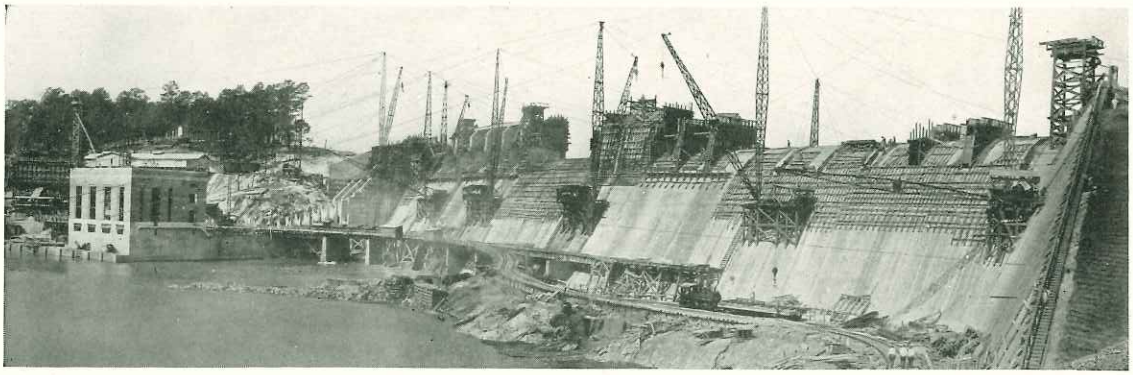
The Consumers Power Co., in reconstructing their plant at Otsego, Michigan, installed two vertical shaft Smith high speed turbines units in concrete vacuum flumes. Each turbine develops 1,150 H. P. at 138.5 R. P. M. under 14.6 feet head.

The most unusual feature of this installation is the substitution of removable plate steel housings enclosing the generators, for the usual type of power house superstructure. This construction is illustrated in the views above.



COLUMBUS ELECTRIC & POWER COMPANY—*Bartletts Ferry Plant*

STONE & WEBSTER, *Engineers*



The view above shows the Bartlett's Ferry Power House and Dam in course of construction across the Chattahoochee River, where the Columbus Electric & Power Co. of Columbus, Georgia, has made an initial installation of two Smith turbine units with provision for increasing the capacity to four units eventually, as will be noted in the exterior view of the plant.

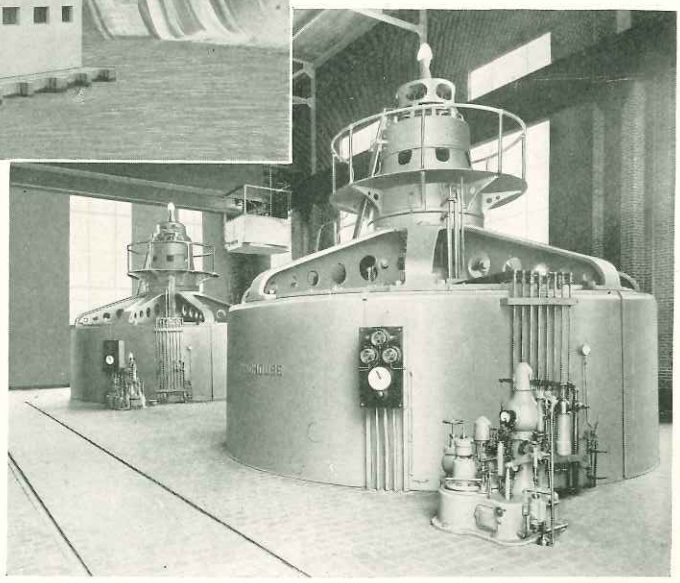
These units operate over a range of head from 112 to 120 feet with a maximum capacity of 29,600 H. P. each at 150 R. P. M.

S. Morgan Smith actuator type governors are used for speed regulation.

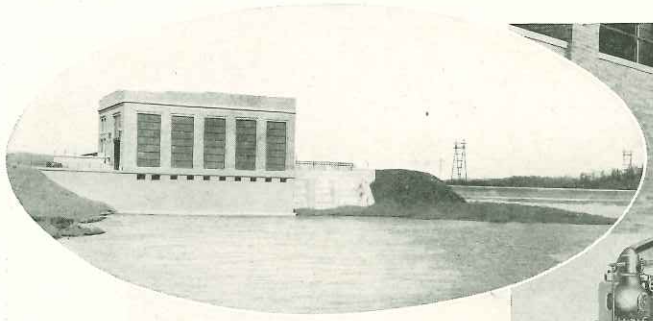
Each of these units in the Bartlett s Ferry Plant consists of a Smith turbine on a vertical shaft mounted in a steel spiral casing, having an inlet diameter of 14′–0″. Thed raft tubes are of the elbow type as recently developed in our testing laboratory.

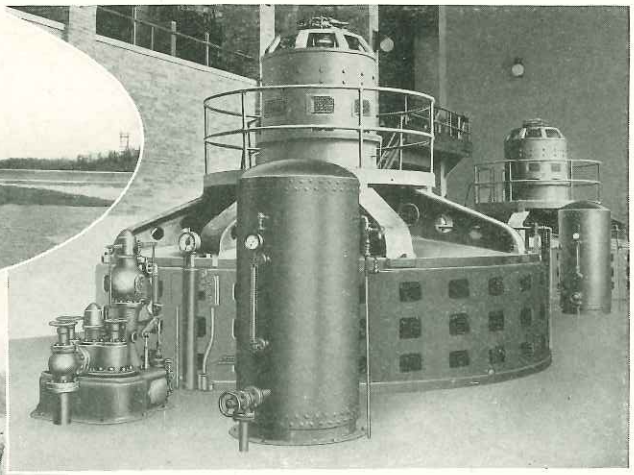
The turbine runners are steel cast in one piece by means of dry sand cores. The regulating gates are cast steel with integral stems. The main guide bearings are of the babbitted type with dual independent oil circulating systems.

In addition to the installation at Bartletts Ferry, the Columbus Electric & Power Co. also has installed Smith turbine equipment at their Goat Rock station on the same river.



STATE OF NEW YORK—*Crescent Dam & Vischers Ferry Plants*



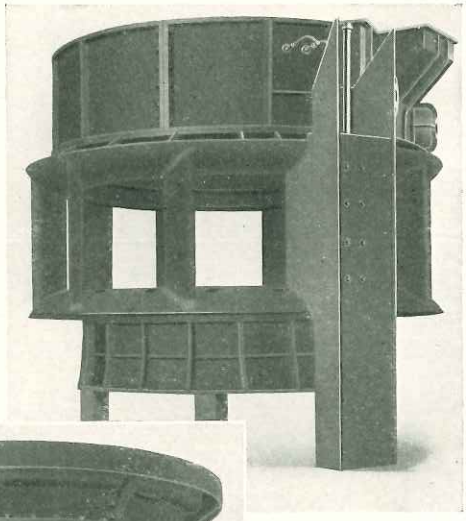


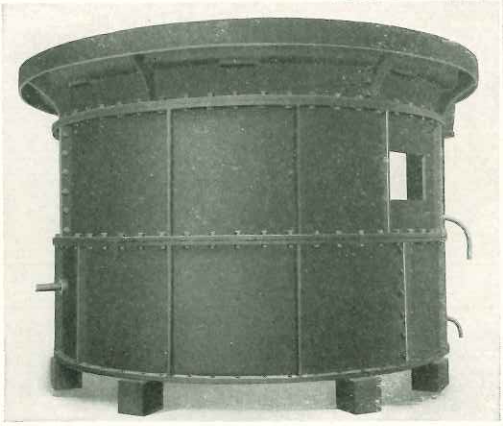
The State of New York has developed two power sites along the canalized section of the Mohawk River near the eastern terminus of the State Barge Canal. The plants are located at Crescent Dam and Vischer's Ferry, and are identical in capacity and equipment.

Each plant contains two vertical shaft high speed Francis type turbines, installed in concrete scroll cases, developing 4,000 H. P. each at 90 R. P. M. under 26.5 feet net head.

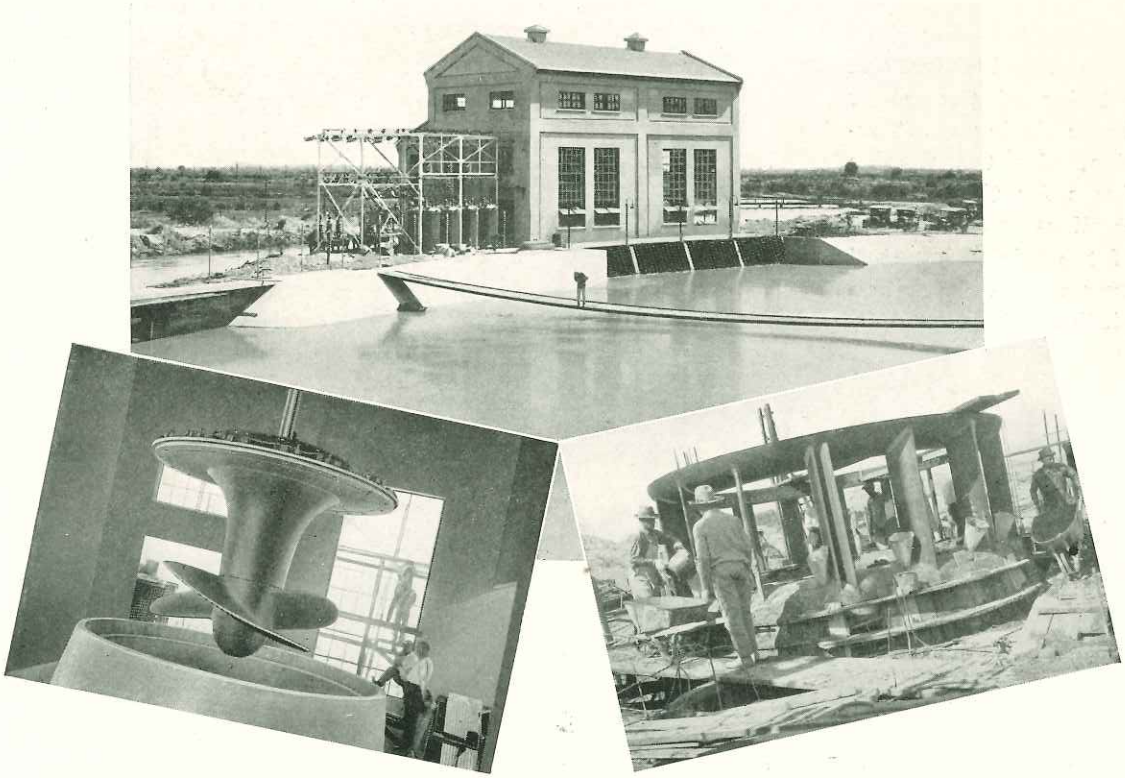
All four units are equipped with Smith actuator type governors.

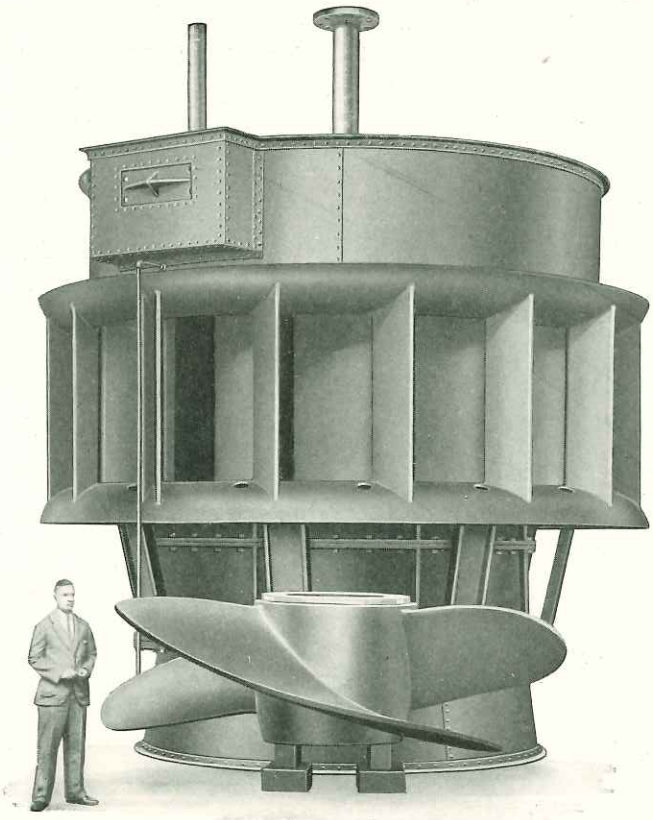
Shop assembly views of speed ring and pit liner are shown.





UNITED STATES RECLAMATION SERVICE—*Siphon Drop Plant, Arizona*





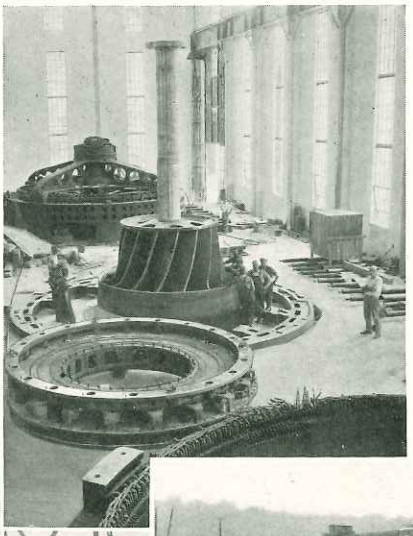
The Siphon Drop plant is located on the main irrigation canal three miles north of Yuma, Arizona, and about ten miles below Laguna dam where the water is diverted from the Colorado River. Part of the power developed is used for pumping on the Yuma Irrigation Project and the surplus is sold to the Southern Sierras Power Co.

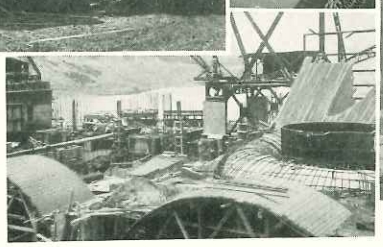
The installation consists of two high-speed type Smith turbines set in semi-spiral type concrete vacuum flumes with concrete elbow type draft tubes. Each unit has a capacity of 1,160 H. P. at 112.5 R. P. M. under 14 feet head.

Interesting construction views of the installation and a factory view of the assembled turbine with the runner are shown.

TALLASSEE POWER COMPANY—*High Rock Development*

The accompaning views show the interior and exterior of the power house during construction, also the wooden forms for the concrete scroll cases and a view of the reinforcing steel over a scroll case with a pit liner set for one unit.

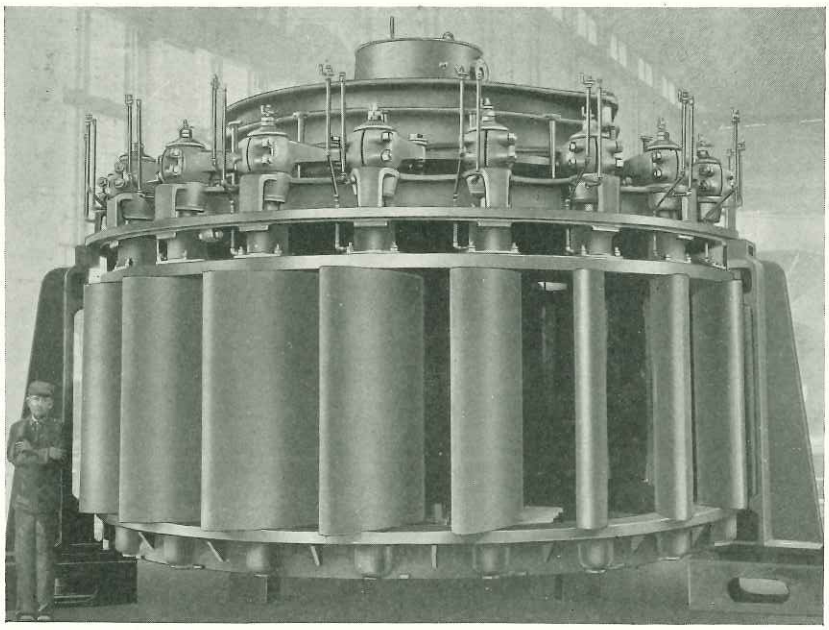




The High Rock development of the Tallassee Power Co. is located on the Yadkin River a short distance below Salis bury, North Carolina. The installation consists of three single runner vertical shaft Smith turbines set in concrete scroll casings and discharging through specially designed concrete elbow type draft tubes. The runners are made of cast iron.

Each unit has a maximum capacity of 18,200 H. P. at a speed of 90 R. P. M. and operates under a head ranging from 30 to 60 feet.

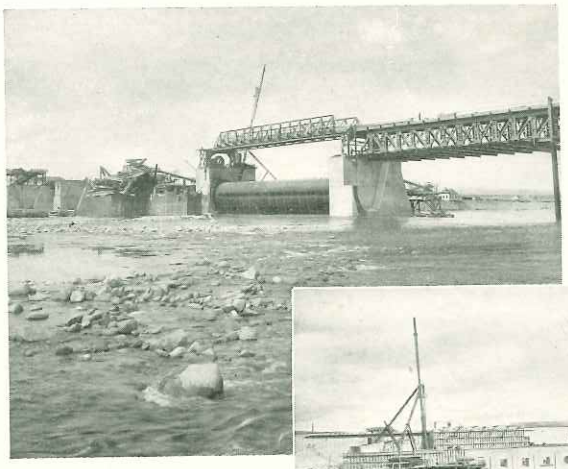
Smith actuator governors regulate the units.

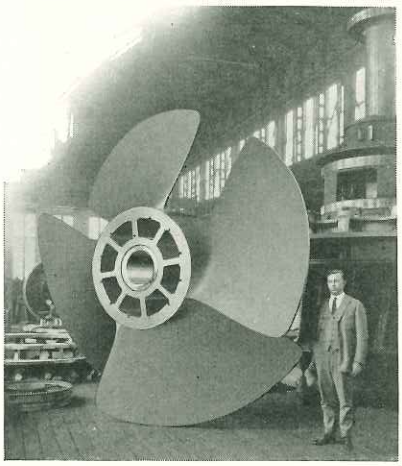


A shop view of one of the turbine units assembled without the speed ring is shown in the accompanying illustration.

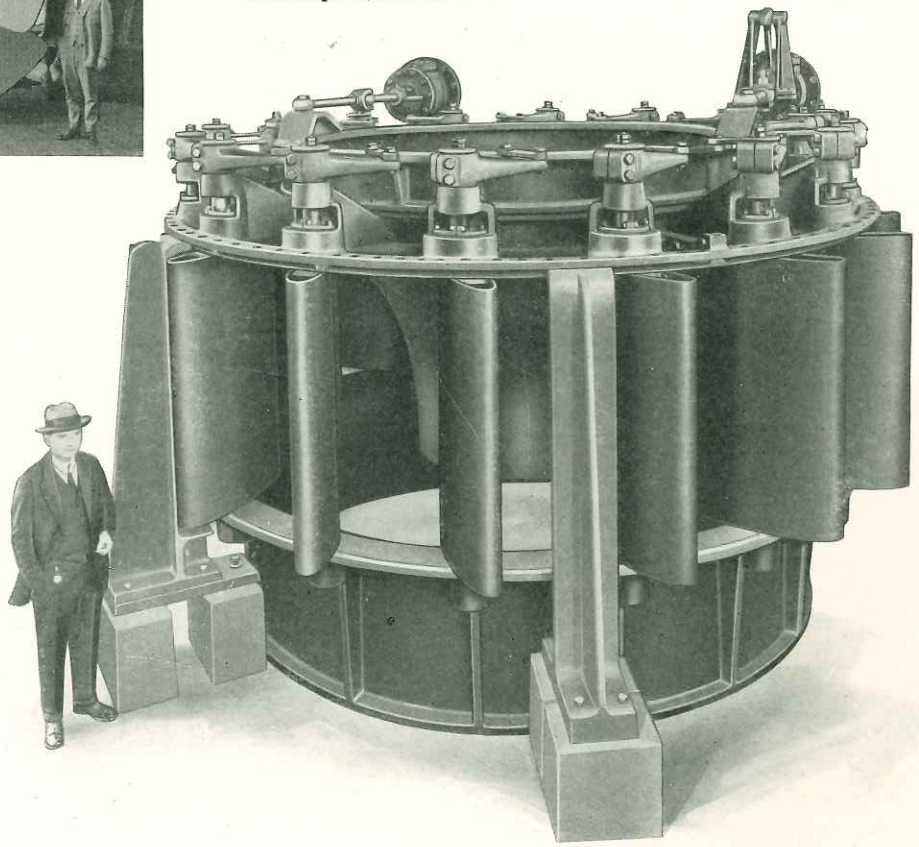
INLAND POWER & LIGHT COMPANY—*Lewiston Development*

The diversion dam of the Inland Pr. & Lt. Co. on the Clearwater River near Lewistown, Idaho, consists of a low concrete base section with a superstructure of three steel roller dams and four needle beam sections, these sections being designed for the future installation of roller dams. The roller dams, of the Smith-M. A. N. design, are each 105 feet long with a daming height of 18 feet.





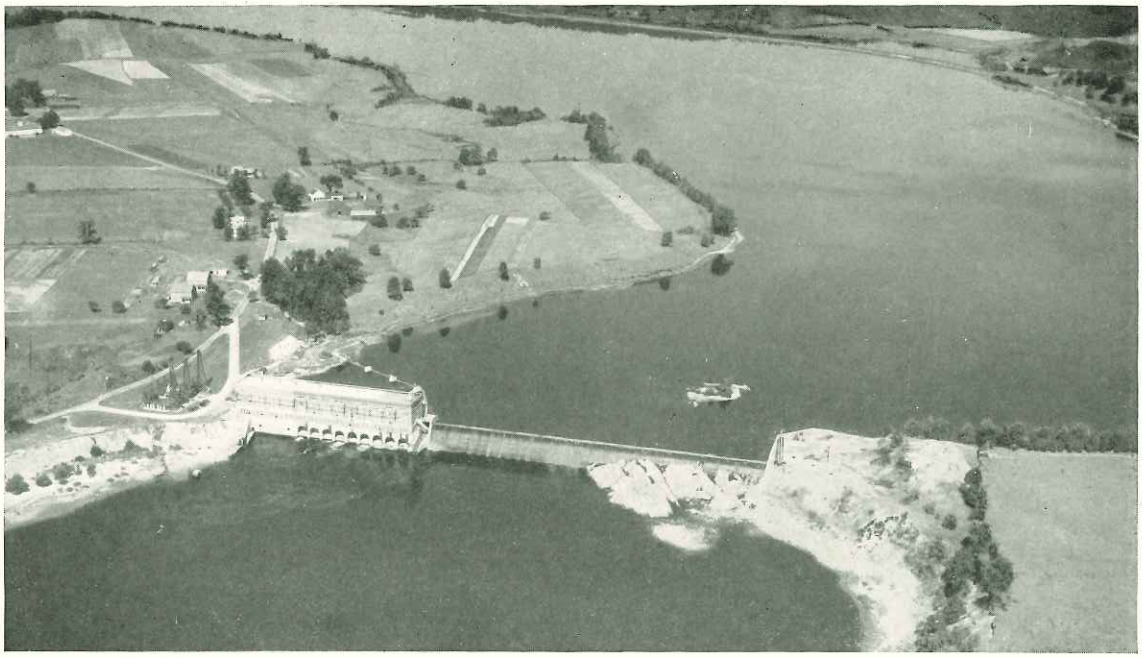
The hydraulic turbine equipment consists of two vertical shaft high-speed type Smith units set in concrete scroll flumes and discharging through elbow type draft tubes. The power house is of the outdoor crane type with the generators enclosed in plate steel housings. Each turbine develops 7,000 H. P. at 138.5 R. P. M. under 35 feet head.



The factory views show one of the high-speed type runners and also the method of assembling the wheel case without the use of the speed rings which were shipped in advance to facilitate the erection of the power house.

NEW ENGLAND POWER COMPANY—*Vernon & Sherman Developments*

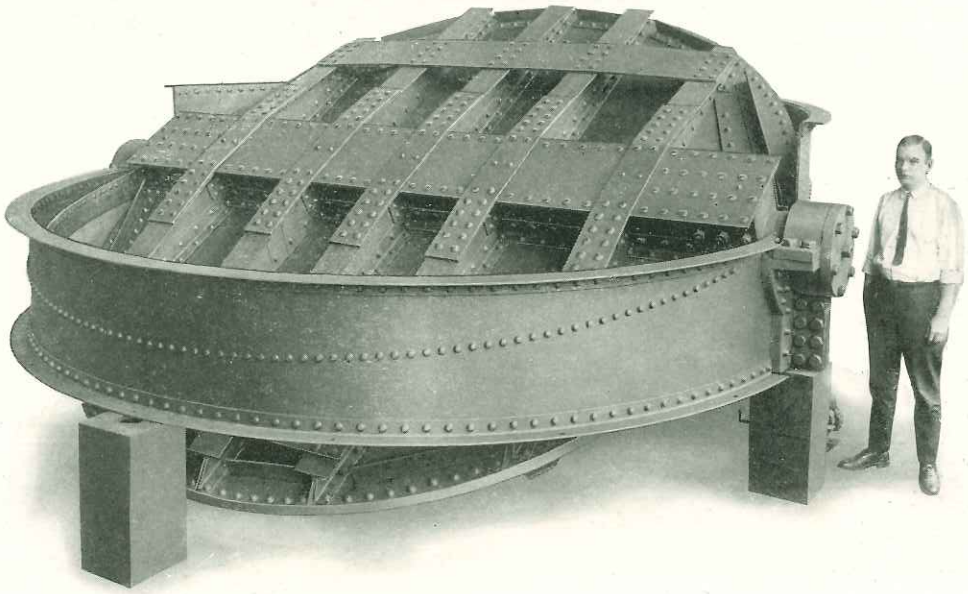
NEW ENGLAND POWER CONSTRUCTION CO., *Engineers*



The New England Power Co. at their Vernon, Vermont, plant on the Connecticut River, has ten units of Smith turbines in operation. Units 1, 2, 3 and 4 develop 4,190 H. P. each at 133.3 R. P. M. under 35 feet head. Units 5, 6, 7 and 8 each are rated at 3,200 H. P. at 133.3 R. P. M., while units 9 and 10 each have a capacity of 6,000 H. P. at 75 R. P. M. under 34 feet head.

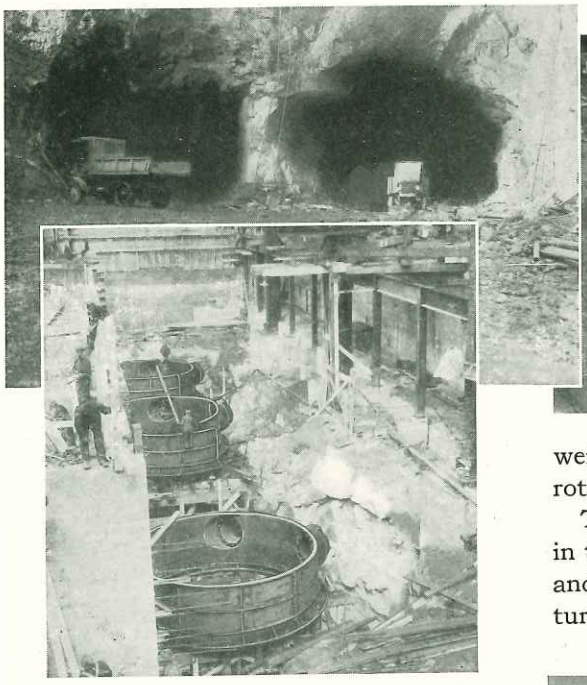
At the Sherman plant there is one single vertical shaft turbine installed in a 10′–0″ inlet diameter steel scroll case. The unit develops 10,390 H. P. at 180 R. P. M. under 86 feet head. A 14′–0″ structural steel Dow valve was furnished with this turbine.

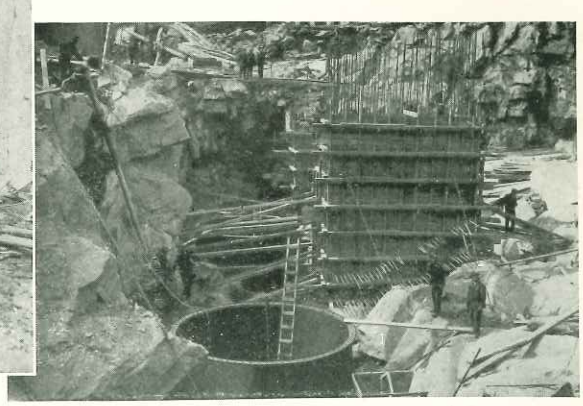
The Sherman plant is a remote controlled station with the controls located at the Davis Bridge plant, over two miles away.



NEW ENGLAND POWER COMPANY—*Bellows Falls Development*

NEW ENGLAND POWER CONSTRUCTION CO., *Engineers*

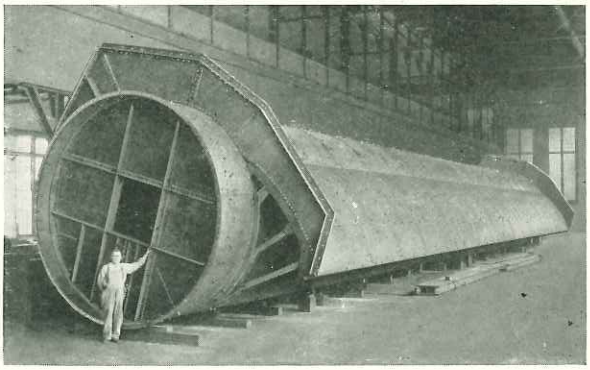




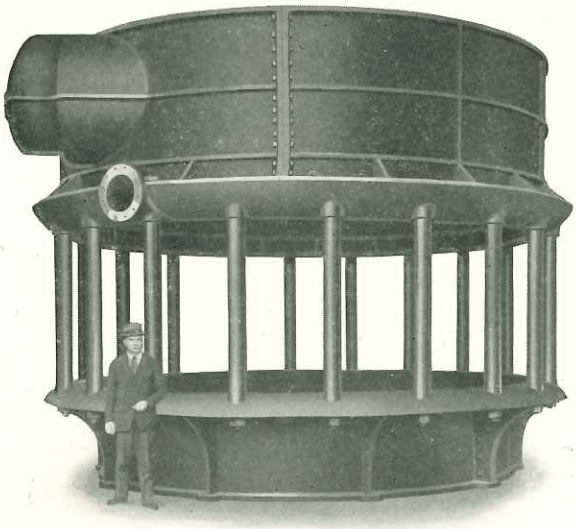
The development at Bellows Falls, Vemont consists of three single vertical shaft turbine units set in concrete spiral casings and discharging through elbow type draft tubes. The rated capacity of each unit is 19,310 H. P. at 85.7 R. P. M. under 57 feet effective head.

Gibbs thrust bearings are provided on separate structural beams below the generators to support the combined weight and thrust of the turbine and generator rotating elements.

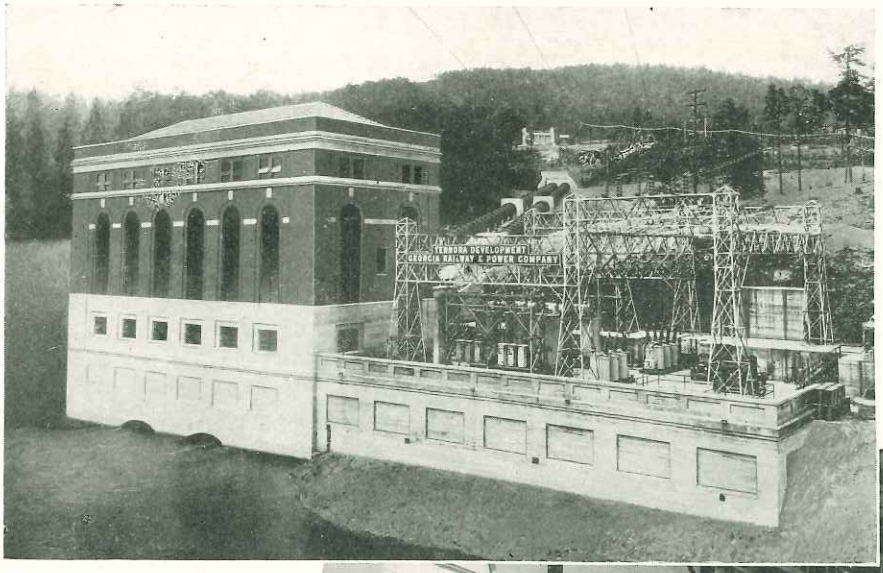
The accompanying views of construction work in the field and the factory views of the speed-ring and the runner show the extraordinary size of these turbines.

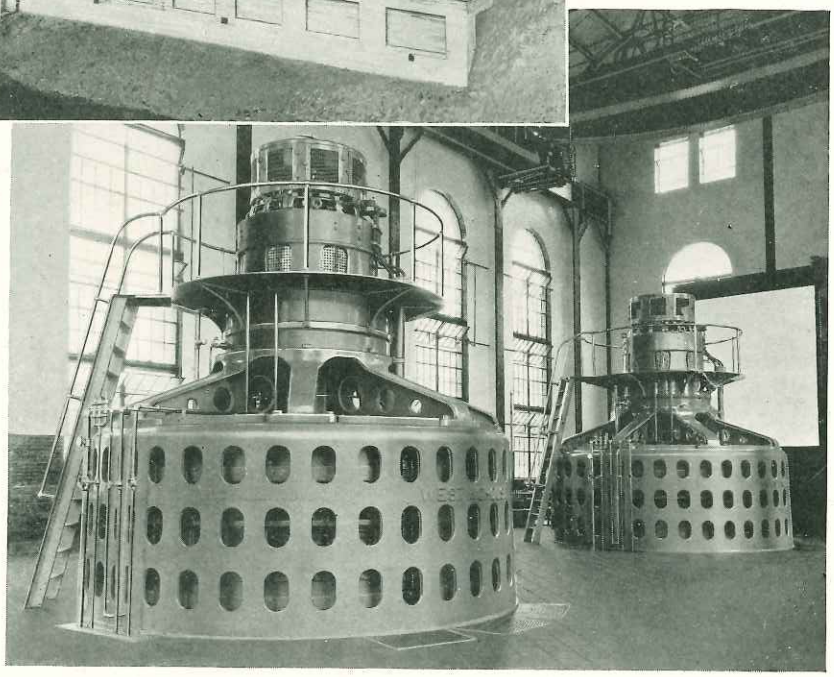


The shop view above illustrates one of the two steel roller crest gates installed at the Bellows Falls diversion dam. Each gate is 18 feet high and 115 feet long between supports.



GEORGIA POWER COMPANY—*Terrora Development*

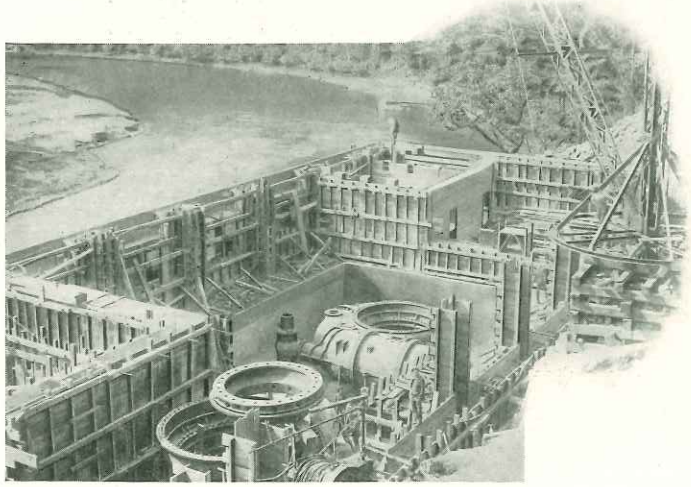




The Georgia Power Co.'s Terrora Development consists of two units of vertical shaft Smith turbines each mounted in an 84″ cast iron spiral case.

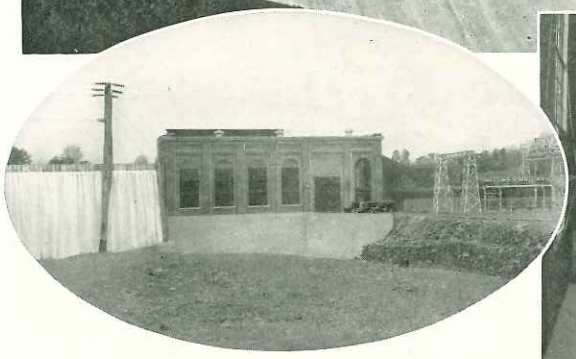
Each of these units develops 15,200 H. P. at an operating speed of 200 R. P. M. under 180 feet head.

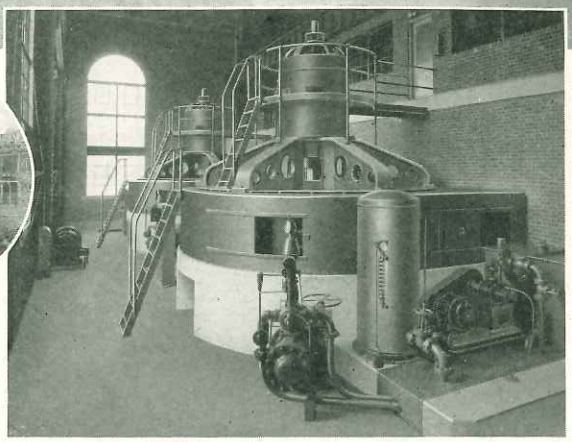
S. Morgan Smith actuator governors and relief valves are used in connection with the regulating mechanism and the generators are equipped with Gibbs oil bath type thrust bearings. The tunnel intake gates, hoists, penstocks and hydraulicly operated gate valves were also furnished by the S. Morgan Smith Co.



FARMINGTON RIVER POWER COMPANY—*Rainbow Plant*

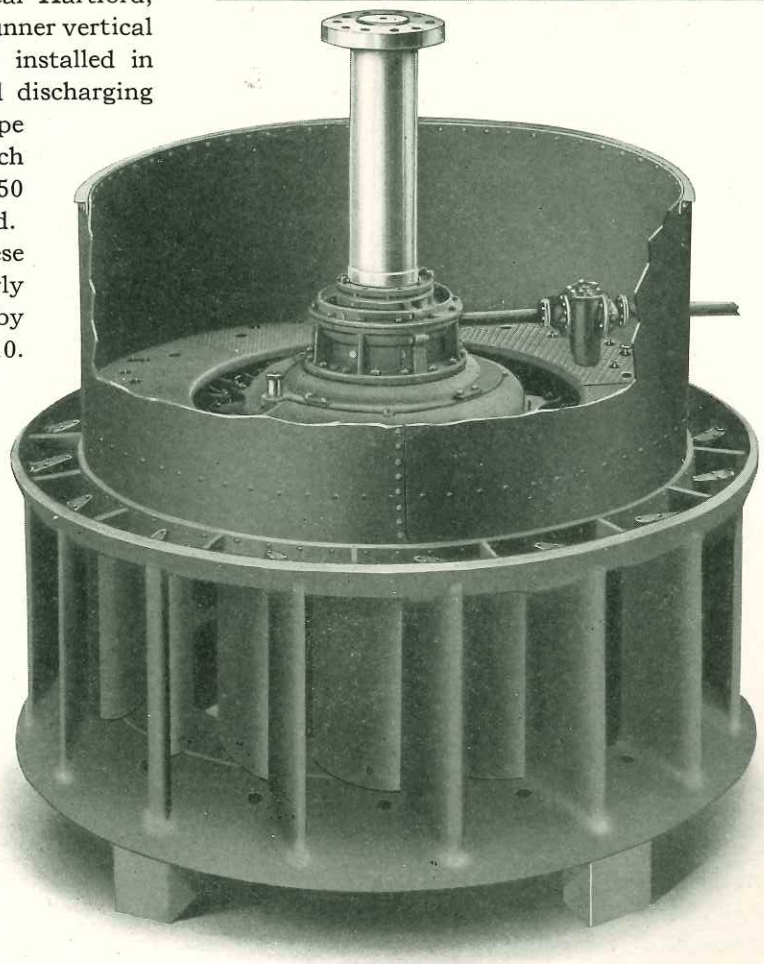
NEW ENG. POWER CONSTRUCTION COMPANY, *Engineers*



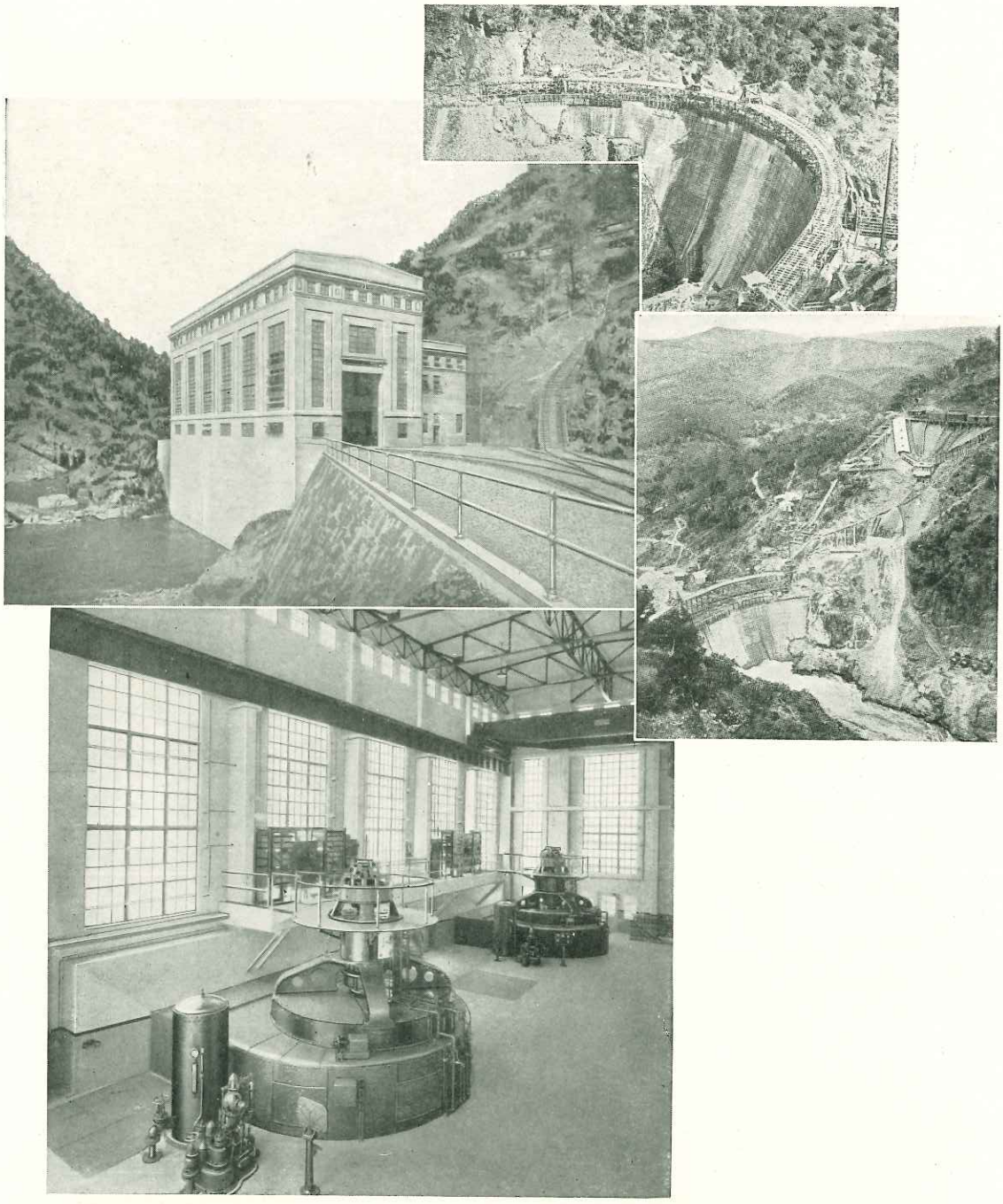


At the Rainbow Plant of the Farmington River Power Co. near Hartford, Conn., there are two single runner vertical shaft Smith turbine units installed in concrete spiral casings and discharging through concrete elbow type draft tubes. These units each develop 6,000 H. P. at 150 R. P. M. under 56 feet head.

In actual field tests these turbines developed nearly 94% efficiency as is shown by the field test curve on page 10.



PACIFIC GAS & ELECTRIC COMPANY—*Melones Plant*

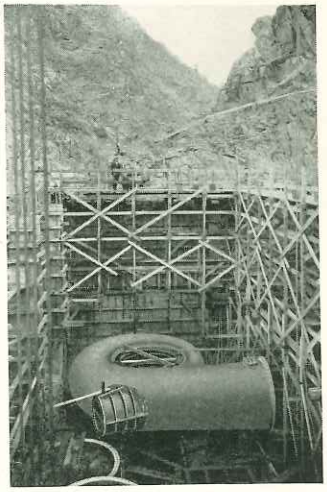


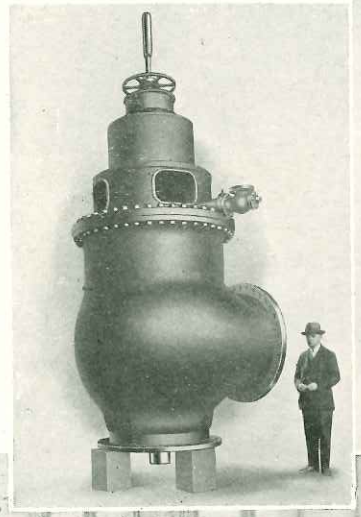
The Pacific Gas and Electric Co. utilizes the power available in the water released from the storage dam of the Oakdale and South San Joaquin Irrigation Districts at the Melones Plant on the Stanislaus River in California. The dam, which is built in a narrow canyon some distance above the power house, rises 185 feet above the stream bed and is 590 feet long at the crest. The water is conveyed to the turbines through 4,700 feet of tunnel and 8′–6″ diam. steel penstocks 150 feet long.

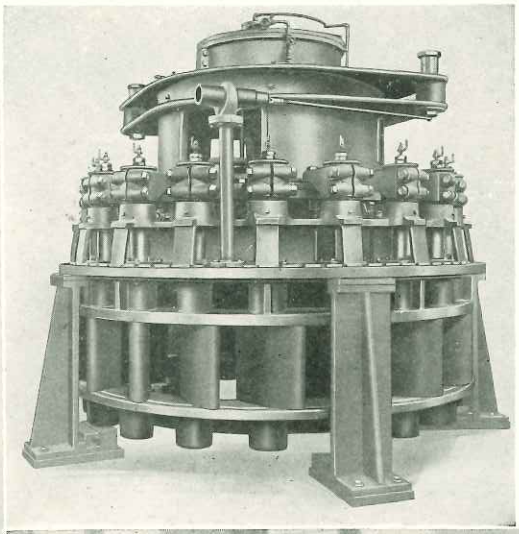
The hydraulic turbine equipment consists of two single runner vertical shaft Smith units set in 7′–6″ inlet diameter steel spiral casings

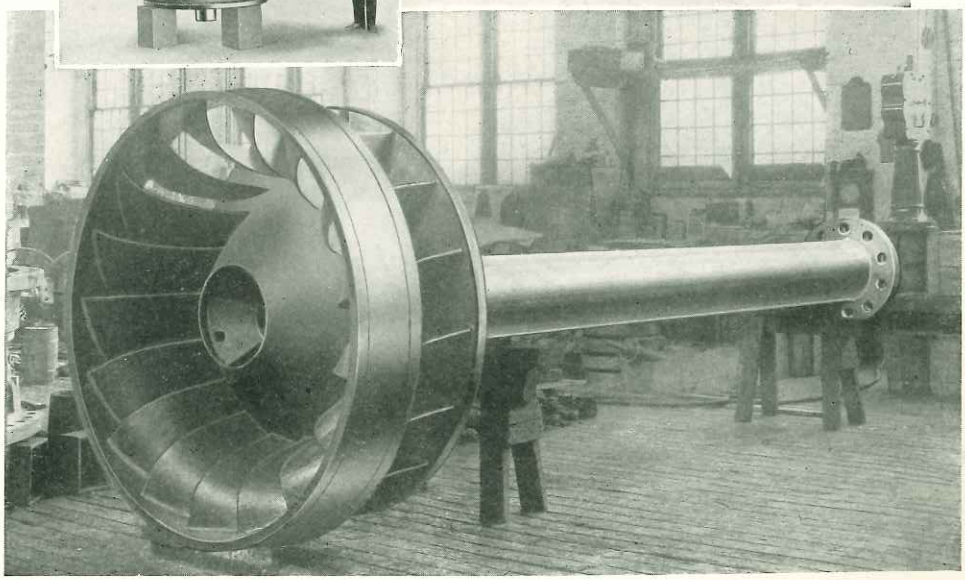
and discharging through concrete elbow type draft tubes. Governor actuated relief valves capable of discharging 100% of the maximum quantity of water taken by the turbines at full gate are connected to the spiral casings to provide pressure regulation. Smith actuator governors control the units. The operating head varies from 125 to 225 feet and the turbines are designed to develop 17,690 H. P. each at 277 R. P. M. when operating under 220 feet head. Field test performance curves showing a maximum efficiency of 94% are reproduced on page 11.

The accompanying construction view shows one of the steel spiral casings being assembled in the power house and the shop assembly views below show a wheel case without the speed ring or spiral casing, a relief valve, and a runner mounted on its shaft for shop balancing tests.









SALT RIVER VALLEY WATER USERS ASSOCIATION

Mormon Flat and Horse Mesa Developments

The developments of the Salt River Valley Water Users Association on the Salt River in Arizona are a notable example of the value of power development in combination with irrigation projects. Starting with the Roosevelt Dam with a storage capacity of 513,000,000,000 gallons of water, the district has expanded rapidly and to meet the growing demand for more water for irrigation purposes they have recently completed two more dams at Mormon Flat and Horse Mesa on the river below Roosevelt Dam. The power developed at these hydro-electric plants is distributed to the farmers in the district for irrigation pumping purposes and for domestic uses. The surplus is sold to the copper mines and smelters in the vicinity. The income from the sale of power, after payment of interest on the district bonds, is used to repay funds advanced by the government for constructing the Roosevelt Dam and to retire bond issues.

At the Mormon Flat development, which is illustrated above, there is installed one single vertical Smith turbine unit set in a 9′–6″ inlet diameter steel scroll casing and discharging through an elbow type draft tube. A 10′–0″ butterfly valve controls the flow of water to the unit. The head varies from 70 to 150 feet, the rated capacity of the turbine being 11,500 H. P. at 214 R. P. M. under 110 feet head.

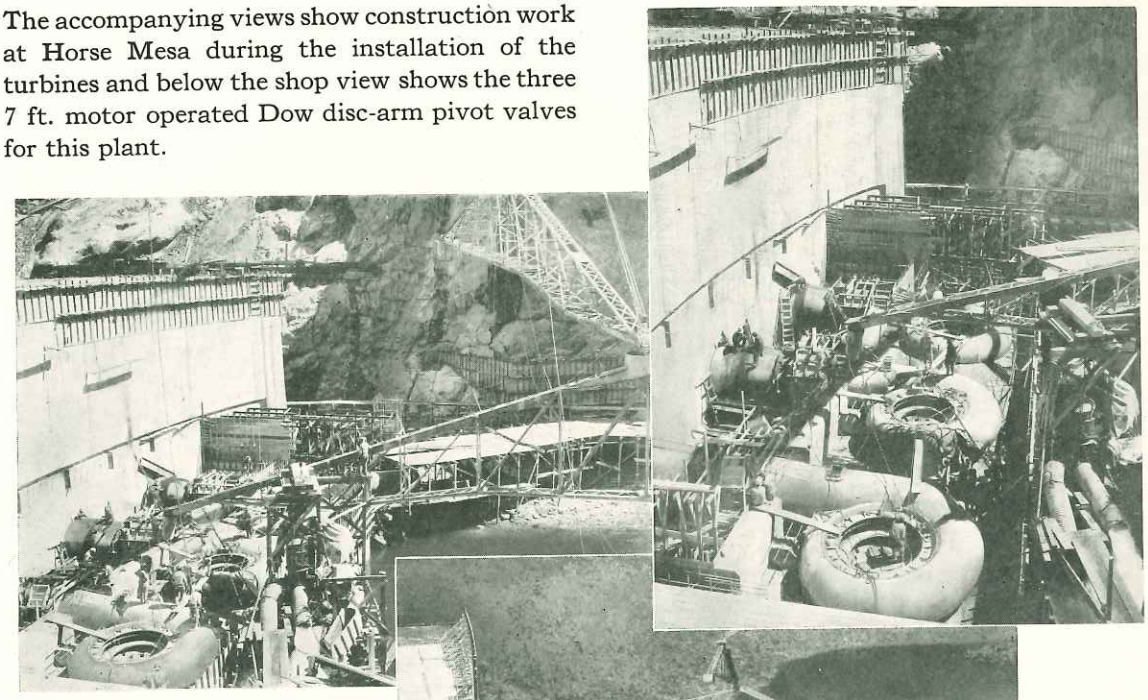
The Horse Mesa dam near Mesa, Arizona, is 306 feet high and provides 245,000 acre feet of storage. The power plant equipment consists of three vertical shaft Smith turbines each set in a 6′–0″ steel spiral casing. The operating head varies from 222 to 270 feet and under the normal head of 284 feet two of the turbines are designed to develop 15,590 H. P. each and the third unit 15,280 H. P. All units operate at 300 R. P. M.

The Stewart Mountain dam, now under construction, will supply an additional 70,000 acre feet of storage and the power house will contain one unit which will operate under an effective head ranging from 50 to 114 feet. This turbine, the order for which has recently been placed with us, will be of the single vertical type set in a steel spiral casing and will develop 17,500 H. P. under the normal head of 100 feet. A 13′–6″ Dow valve will be furnished with the turbine.

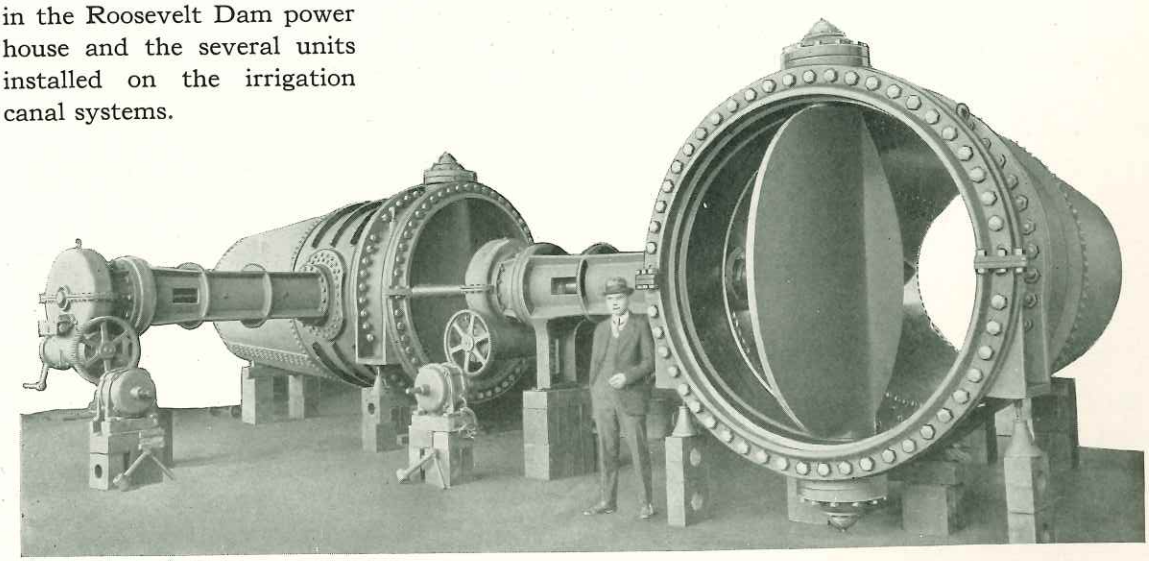
SALT RIVER VALLEY WATER USERS ASSOCIATION

Mormon Flat and Horse Mesa Developments

The accompanying views show construction work at Horse Mesa during the installation of the turbines and below the shop view shows the three 7 ft. motor operated Dow disc-arm pivot valves for this plant.

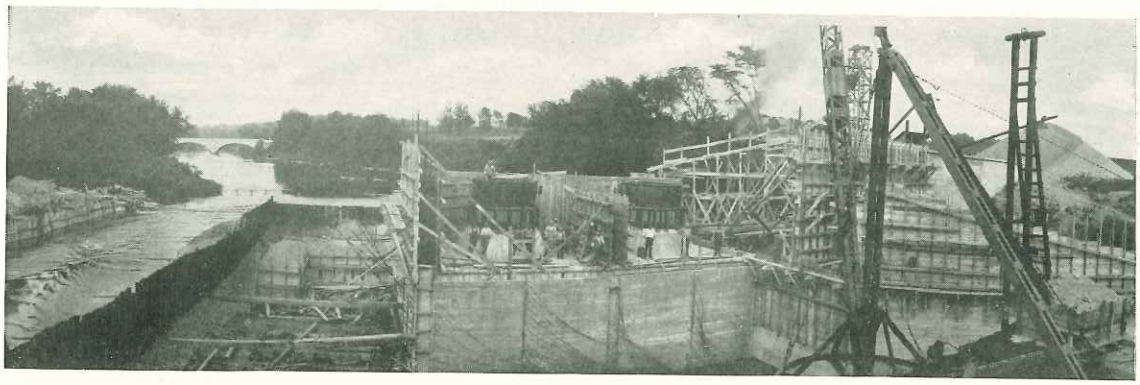


Smith turbines in operation or now under construction for the Salt River Valley Water Users Association develop a total of one hundred and ten thousand horse power. This total includes the power developed by the seven Smith units installed in the Roosevelt Dam power house and the several units installed on the irrigation canal systems.



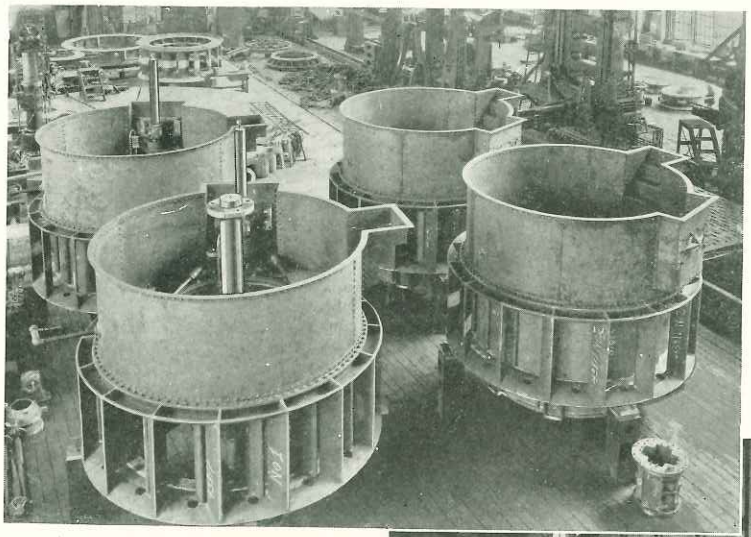
MICHIGAN WATER POWER COMPANY—*Cascade and Ada Plants*

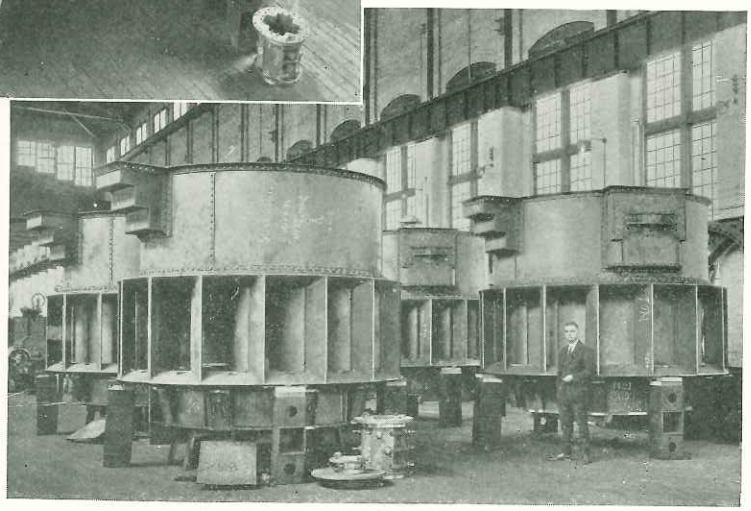
SPOONER & MERRILL, *Engineers*



The construction view above shows the Cascade Plant of the Michigan Water Power Co. on the Thornapple River near Grand Rapids, Michigan. The speed rings and the pit liners for the two vertical turbine units are shown already in place. These units are of the Smith high-speed axial flow type set in closed concrete flumes and discharging through vertical plate steel draft tubes. Each unit is designed to develop a maximum of 1,875 H. P. at 200 R. P. M. under 27 feet effective head.

The units are controlled by gate shaft type governors operation under remote control from the Ada plant.

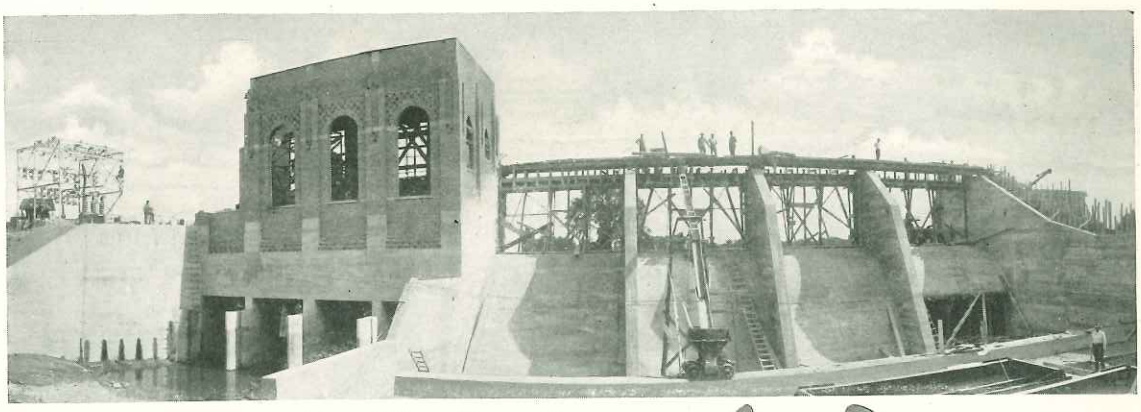




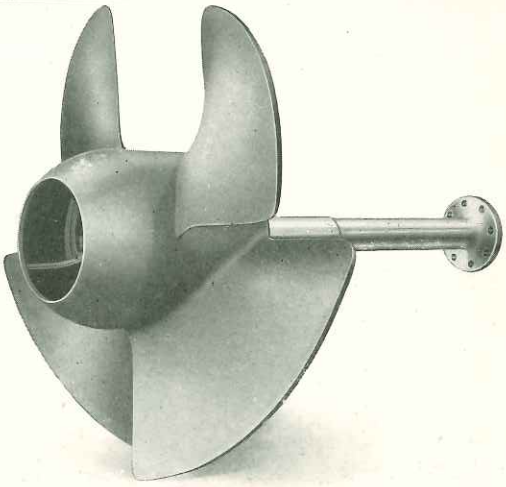
Shop assembly views of the four turbines built for the Cascade and Ada Plants of the Michigan Water Power Co.

MICHIGAN WATER POWER COMPANY—*Cascade and Ada Plants*

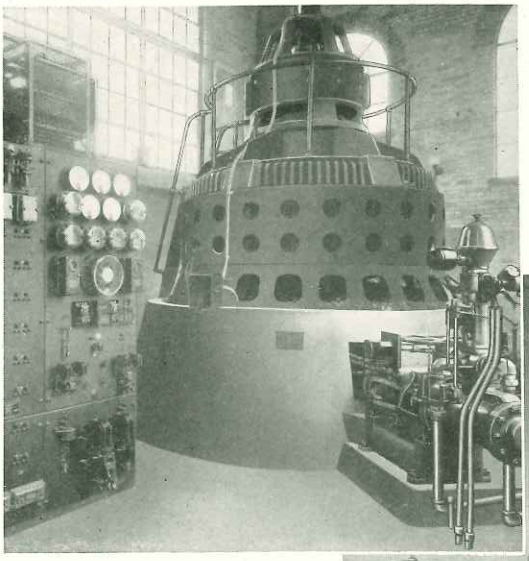
SPOONER & MERRILL, *Engineers*

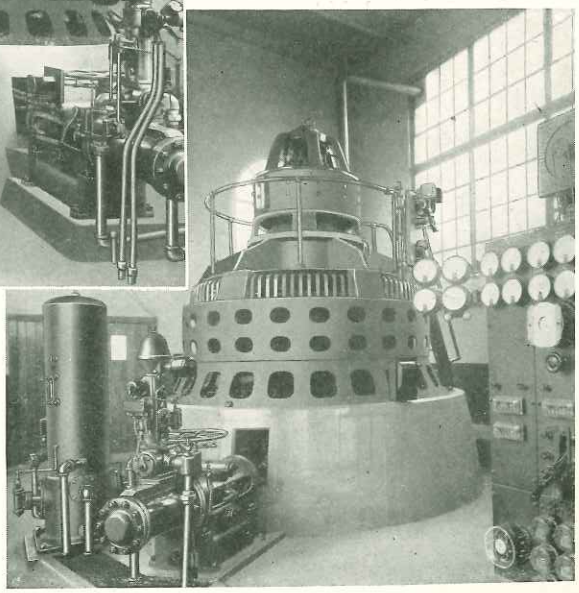


The Ada plant of the Michigan Water Power Co. is located on the same stream and several miles below the Cascade Plant. Both developments were made at the same time and the turbine equipment in each is identical in design and in size. At the Ada Plant the head is 22 feet and the two units each develop 1,450 H. P. at 180 R. P. M.



Turbine runner and shaft as used in the Ada and Cascade units.



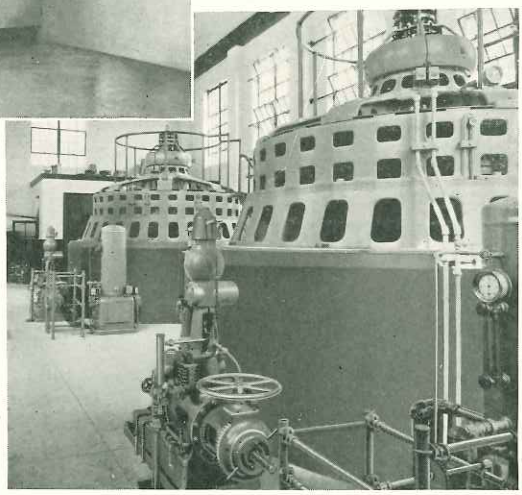


Views of the generator rooms at Ada and Cascade showing one unit of each plant together with the automatic governor control equipment.

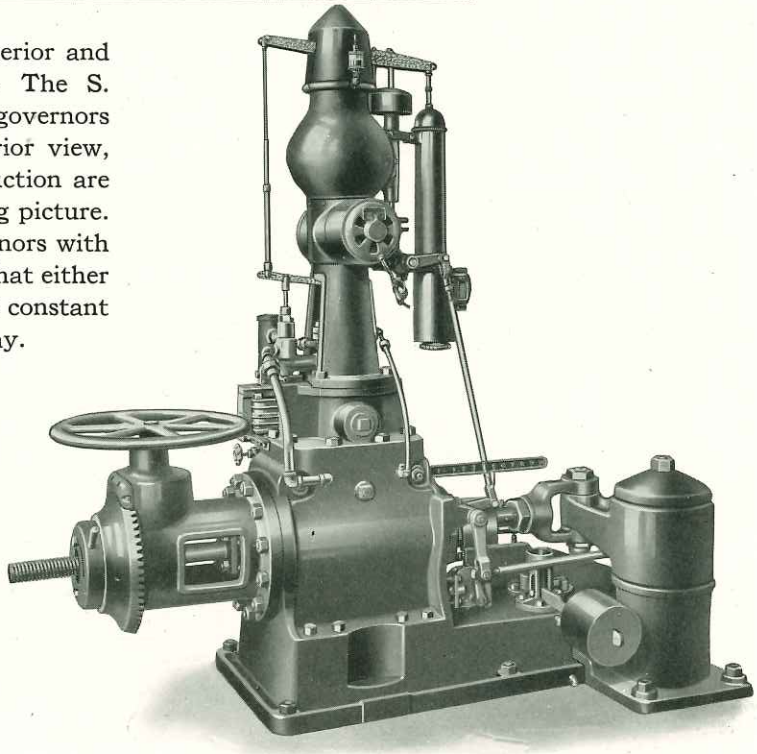
BIBB MANUFACTURING COMPANY—*Porterdale, Georgia*

ADSIT & HAMMOND, *Engineers*

The prime mover equipment at the Bibb Manufacturing Co.'s hydro-electric development at Porterdale, Georgia, comprises two vertical shaft Smith turbine units in 7′–0″ inlet diameter steel spiral casings, each unit having a capacity of 1,653 H. P. under 48 feet effective head.

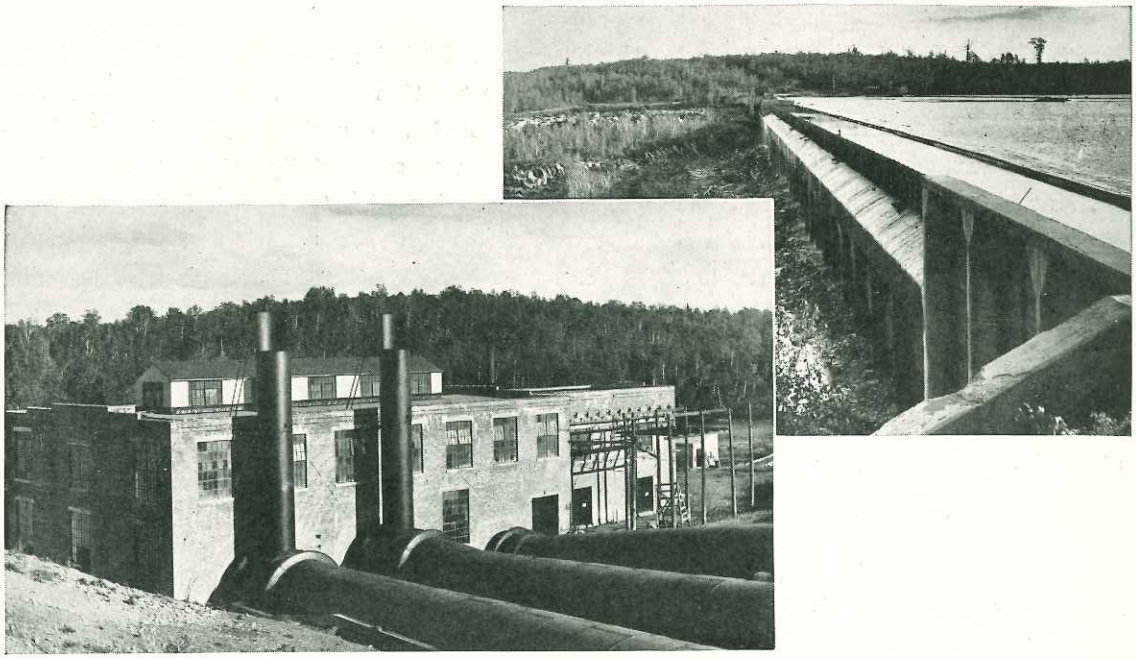


The views above show the interior and exterior of the power plant. The S. Morgan Smith gate shaft type governors are clearly shown in the interior view, while the details of its construction are illustrated in the accompanying picture. These are full automatic governors with float level control so designed that either one or both units will maintain constant level at the dam 1,000 feet away.



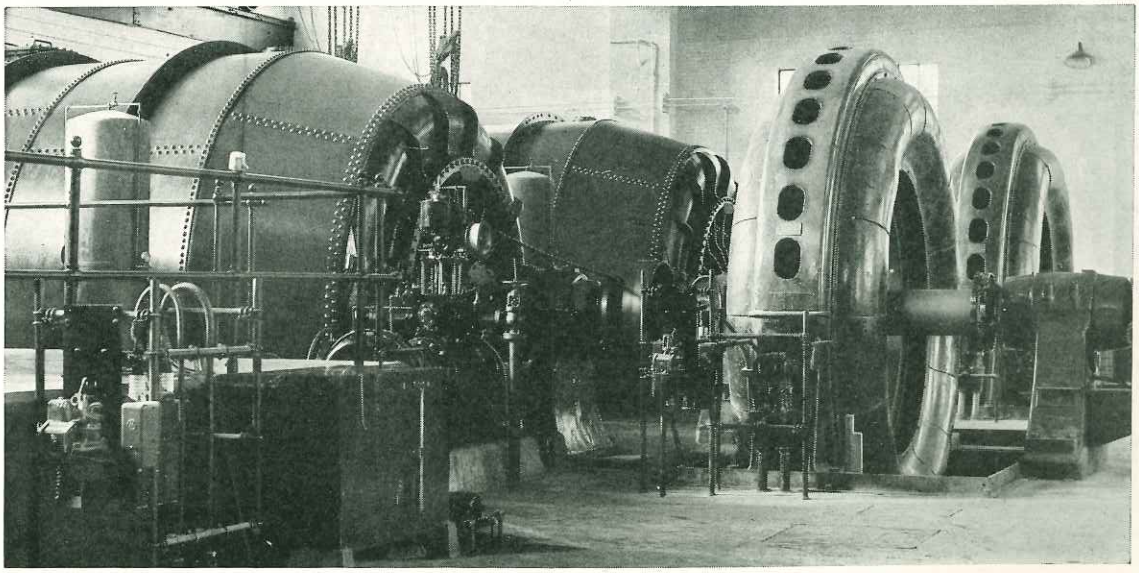
SAINT CROIX PAPER COMPANY—*Grand Falls, Maine*

GEO. F. HARDY, *Consulting Engineer*



The reconstruction of the hydraulic turbine equipment for the St. Croix Paper Co. included the installation of two horizontal shaft twin wheel units; each unit consisting of a pair of Smith turbines on a draft-chest in a 16′–6″ diameter end-supply plate steel pressure case with a rated capacity of 4,200 H. P. at 187.5 R. P. M. under 48 feet head.

These turbines were installed in connection with the existing supply pipes and elbow type concrete draft tubes, and were direct connected to generators already in place. The results shown by the field test curve on page 11 are very remarkable considering that the old draft tubes were used without alterations of any kind.



NORTHERN NEW YORK UTILITIES

Black River Plants

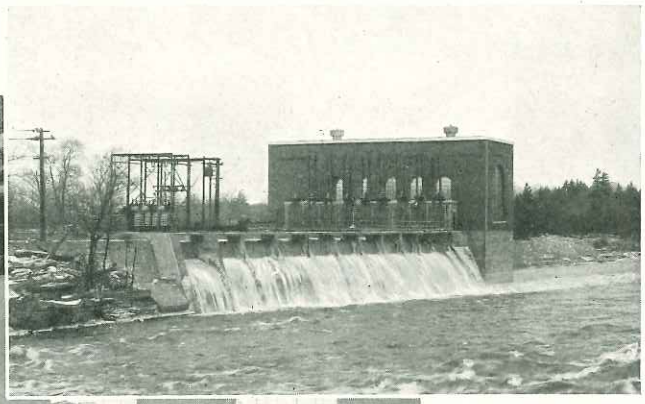
Smith turbine installations for the Northern New York Utilities Co. of Watertown, New York, include three plants on the Black River as here illustrated.

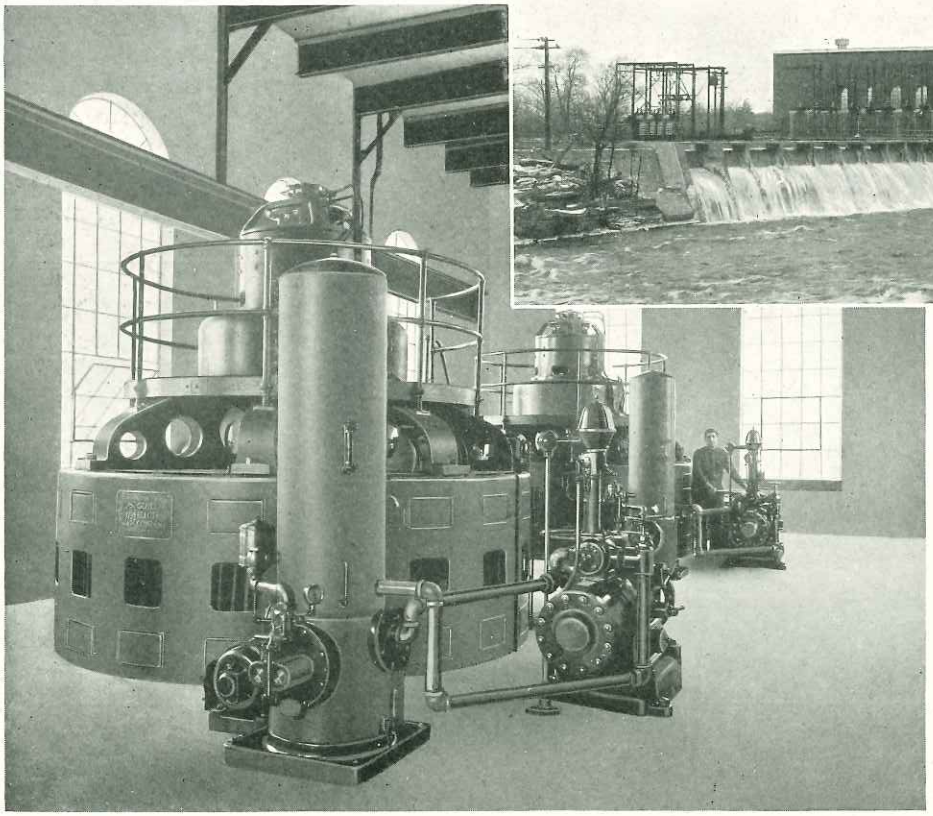
Plant No. 2 is equipped with three vertical shaft turbines in concrete spiral cases, each unit developing 3,250 H. P. at 120 R. P. M. under 33 feet head.

Plant No. 3 contains three single vertical shaft turbines installed in open concrete flumes; the capacity of each being 2,200 H. P. at 100 R. P. M. under 22 feet head.

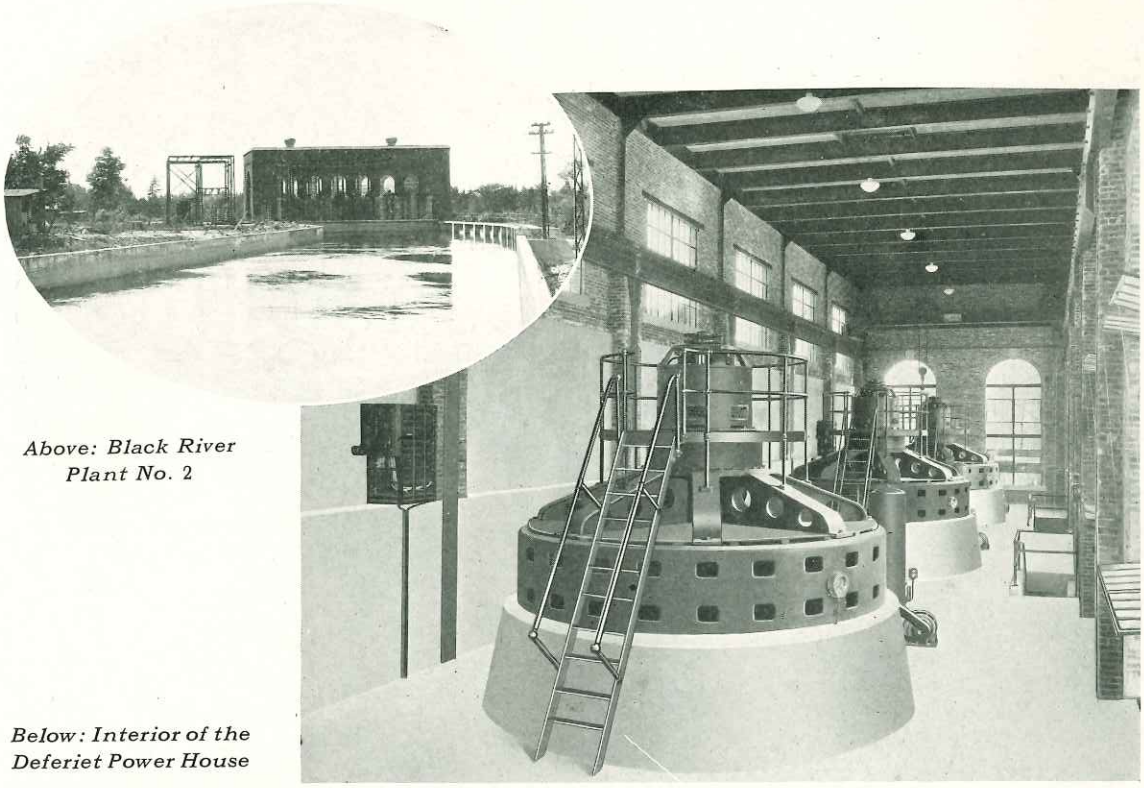
The Deferiet development involved the reconstruction of an existing plant and presented a complex engineering problem which was successfully solved through close cooperation with the Power Co's. Engineers. The design finally adopted consisted of turbines in steel spiral casings with plate steel elbow type draft tube forms over which the concrete for the sub-structure was poured. The three vertical shaft units each develop 4,960 H. P. at 128.6 R. P. M. under 46.2 feet head.

Below: Black River Plant No. 3



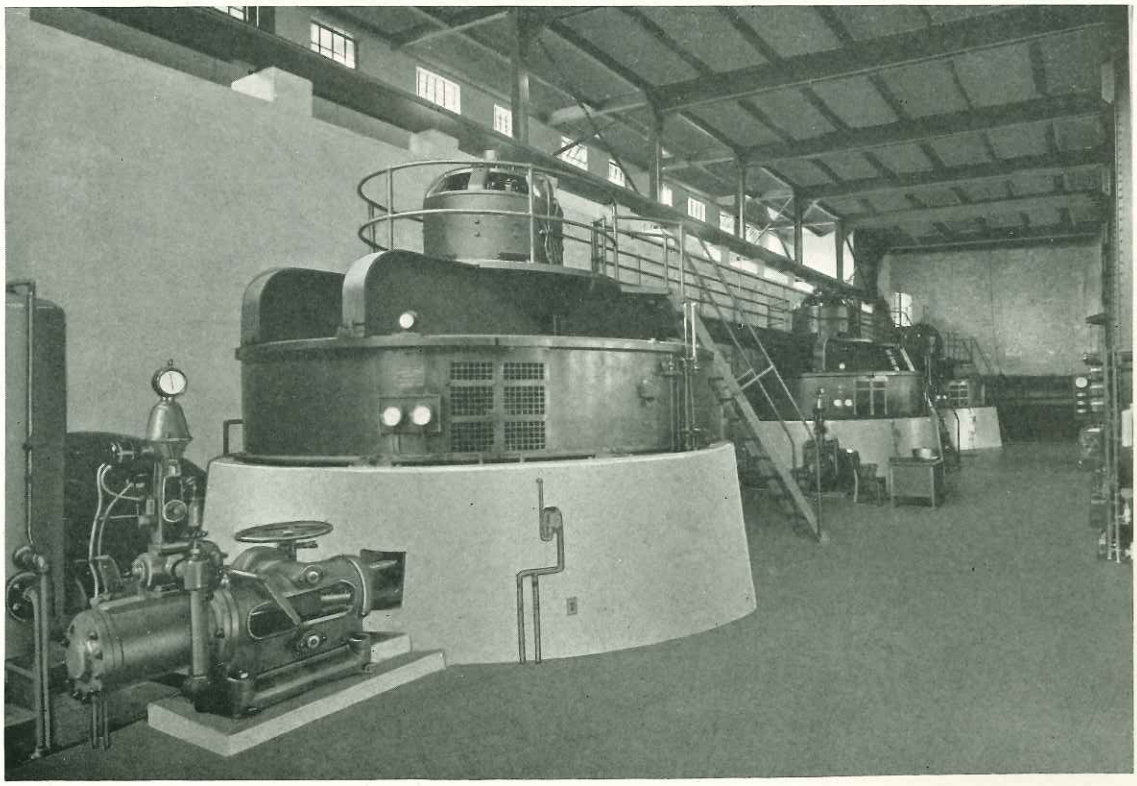


NORTHERN NEW YORK UTILITIES—*Black River Plants*



Above: Black River Plant No. 2

Below: Interior of the Deferiet Power House

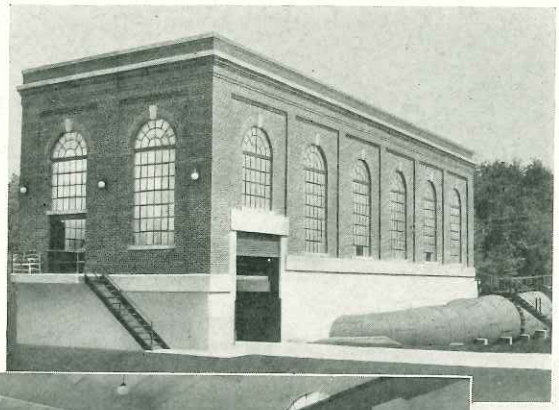


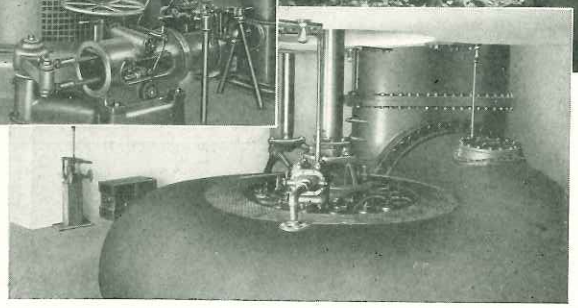
BEAVER RIVER POWER CORP.—*High Falls Plant*

E. E. WHITNEY, *Engineer*

The High Falls hydro-electric development is located on the Beaver River near Croghan, New York. The equipment consists of an initial installation of three units with provision for a fourth unit in the future. Each of the turbines is of the single vertical shaft type enclosed in a 6 ft. diameter steel spiral case developing 2,750 H. P. at 400 R. P. M. under a working head of 100 feet. Water is supplied to the turbines through a 12 ft. diameter plate steel penstock about 1,000 feet in length. The manifold connection at the power house has four branches, each equipped with a motor operated gate valve at the scroll inlet.

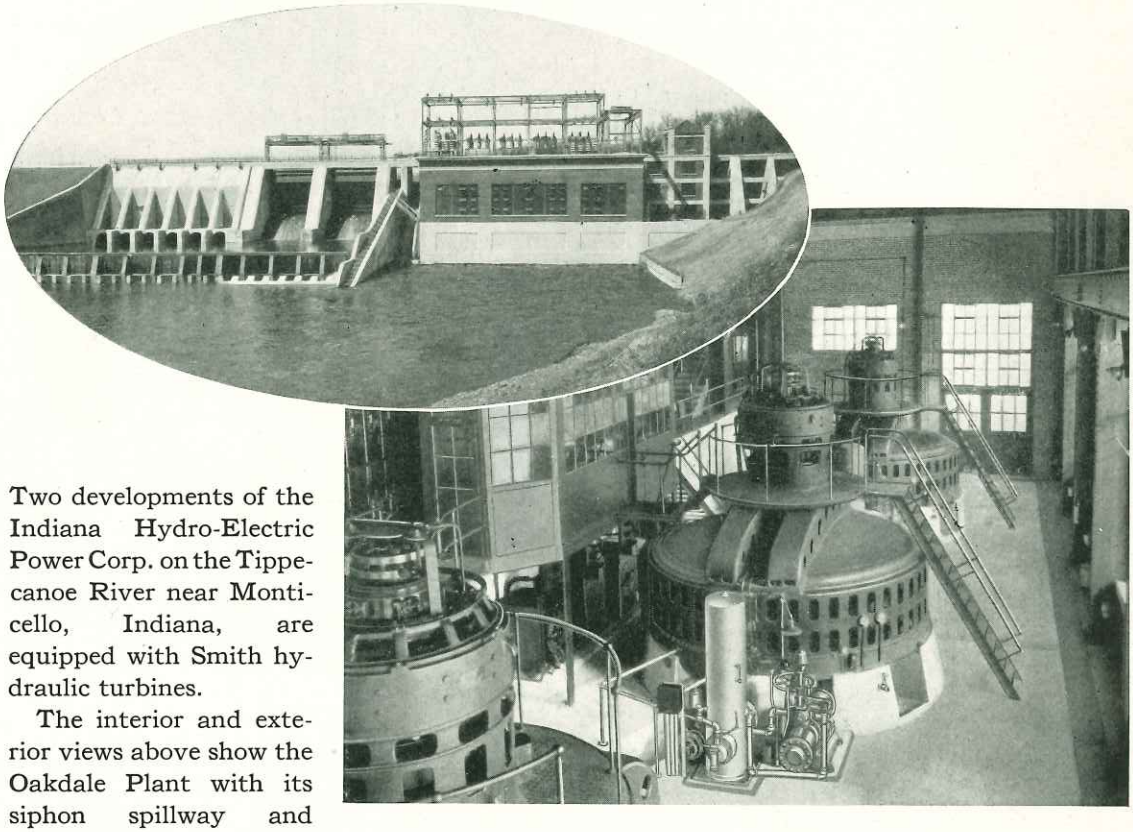
The accompanying interior and exterior views show interesting features of the installation.





INDIANA HYDRO-ELECTRIC POWER CORP.—*Tippecanoe River Developments*

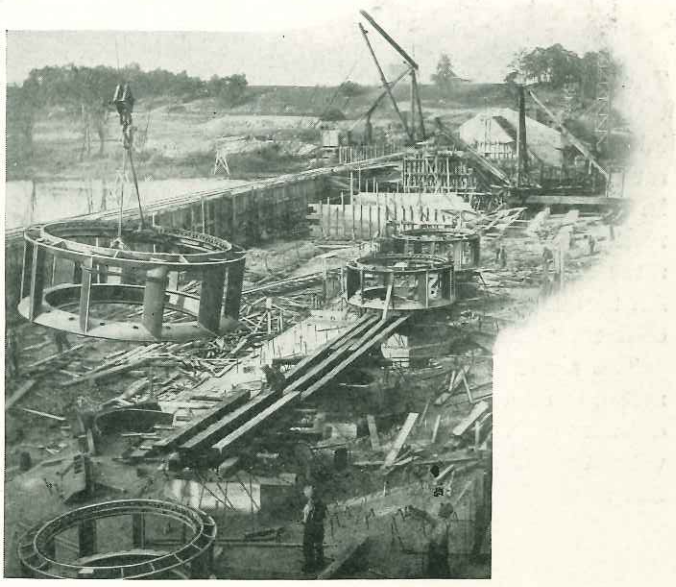
ROGER M. FREEMAN, *Engineer*



Two developments of the Indiana Hydro-Electric Power Corp. on the Tippecanoe River near Monticello, Indiana, are equipped with Smith hydraulic turbines.

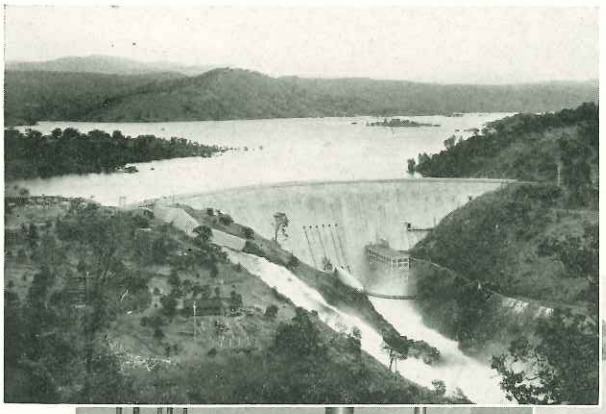
The interior and exterior views above show the Oakdale Plant with its siphon spillway and spillway basin. Three single vertical shaft units are installed in concrete spiral flumes. Two of these units are of the high speed Francis type each developing 5,100 H. P. at 183.6 R. P. M. under 42 feet head; the third unit is a medium speed turbine of 4,350 H. P. capacity at 120 R. P. M. under the same operating head.

The construction view at the right shows the Norway Development which is located a few miles upstream from the Oakdale Plant. The four vertical shaft single runner units installed at Norway are set in concrete spiral flumes. Three of the units are rated at 2,900 H. P. each at 120 R. P. M. and the fourth unit develops 1,700 H. P. at 150 R. P. M., all operating under a head of 30 feet.

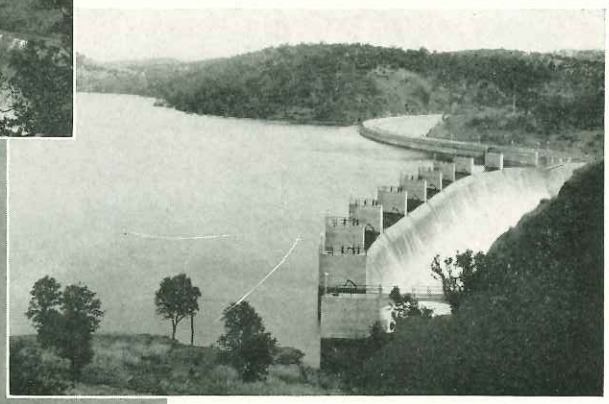


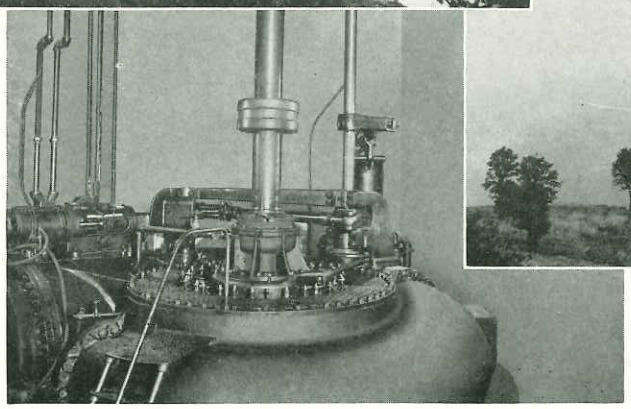
TURLOCK & MODESTO IRRIGATION DISTRICTS OF CALIFORNIA—
Don Pedro Dam Development

A. S. WILEY, *Consulting Engineer*



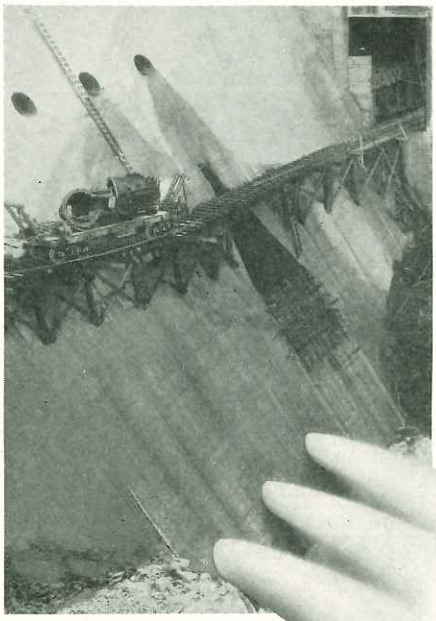
The Don Pedro Dam on the Toulumne River near La Grange, California, is the storage reservoir built by the Turlock and the Modesto Irrigation Districts. The accompanying views show the dam and one of the Smith turbine units in the power house.





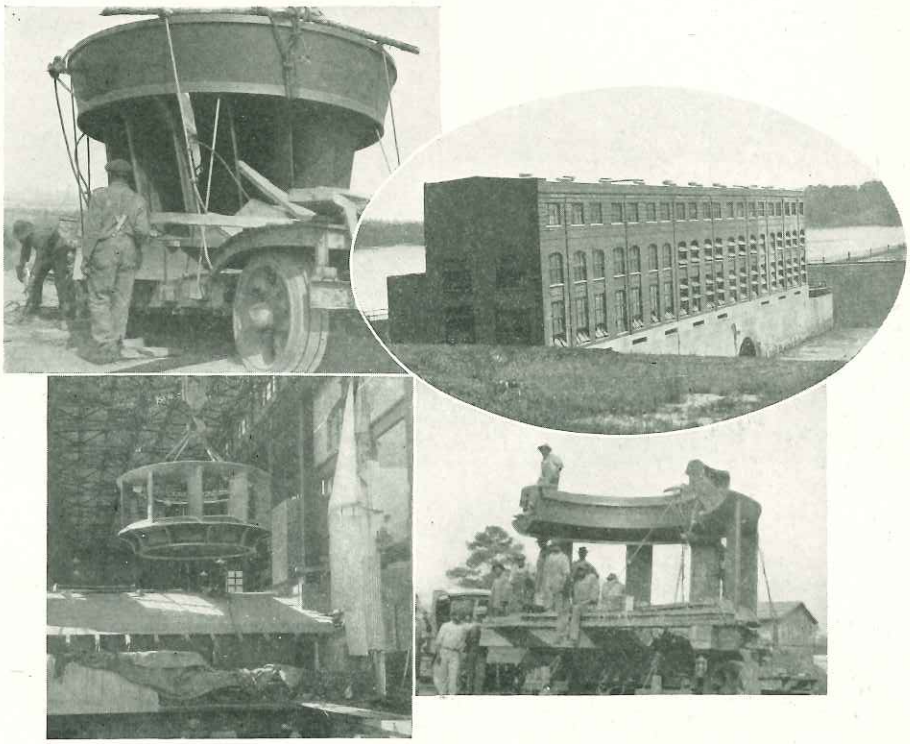
The original hydraulic equipment consisted of three vertical shaft Smith turbines set in 5′–0″ inlet diameter cast iron scroll cases each with a rated capacity of 7,200 H. P. under 160 feet head. In 1927 two additional Smith units in 6′–0″ cast steel scroll cases were installed. These units are rated at 10,500 H. P. each under 180 feet head. All turbines operate at a speed of 300 R. P. M. over the full range of from 100 to 240 feet head.

The construction view at the right shows the method of moving the turbine parts across the downstream face of the dam to the power house with the sluice gates discharging under 70 feet head.

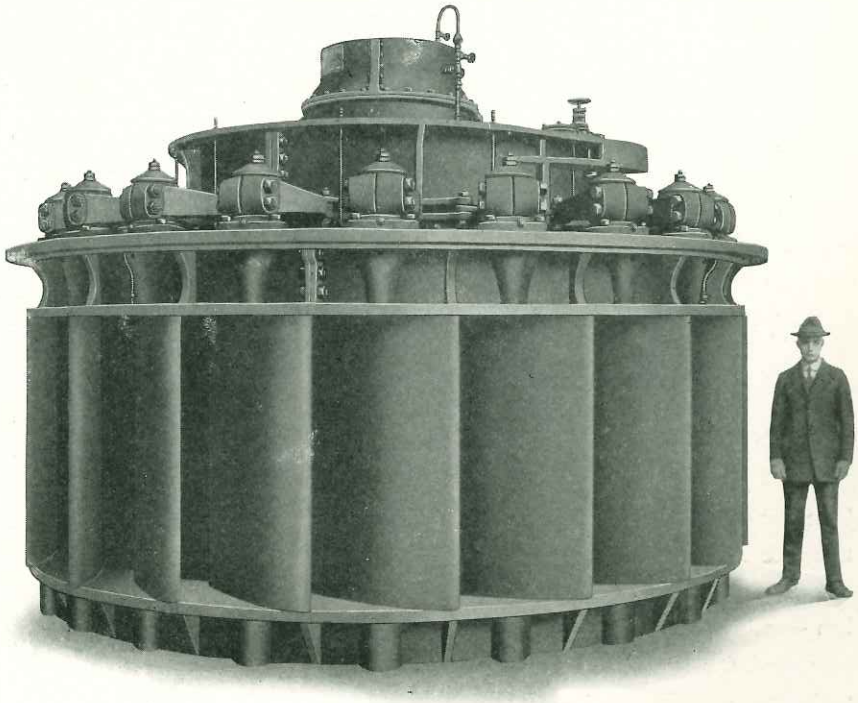


AUGUSTA-AIKEN RAILWAY & ELECTRIC CO.—*Stevens Creek Plant*

J. G. WHITE ENGINEERING CORP., *Engineers*



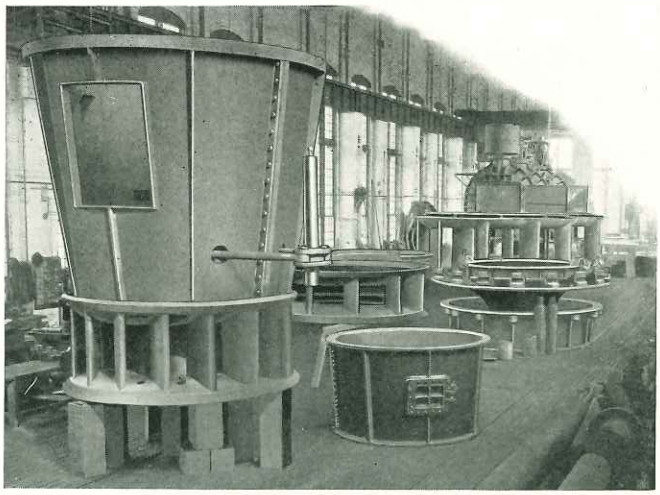
The hydraulic turbine equipment installed in the Stevens Creek Plant of the Augusta-Aiken Railway and Electric Co., near Augusta, Georgia, includes three vertical Smith turbines set in concrete spirals and discharging through elbow type draft tubes.

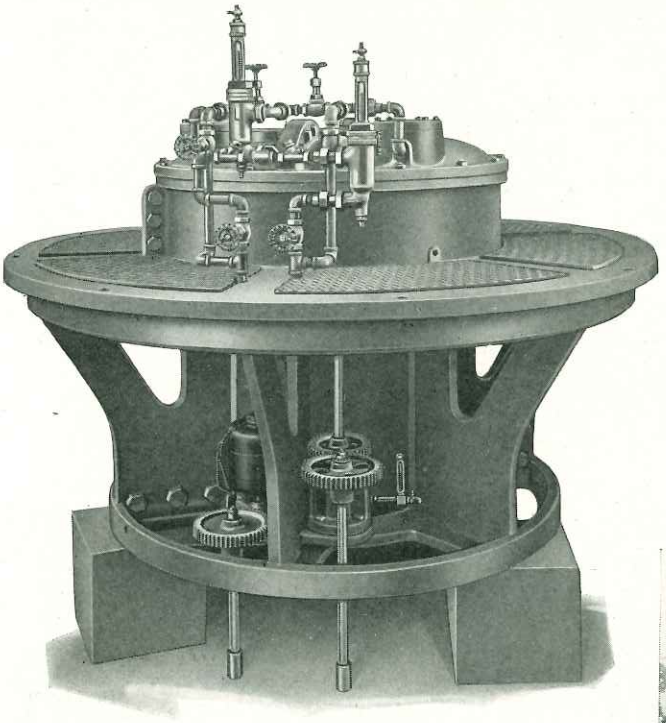


The accompanying illustrations show the exterior of the power plant and construction views during the installation of Smith turbine units. Shop assembly of one of the turbines without the speed ring is also shown.

Under a working head of 27 feet, each Smith unit develops 3,125 H. P. at a speed of 75 R. P. M.

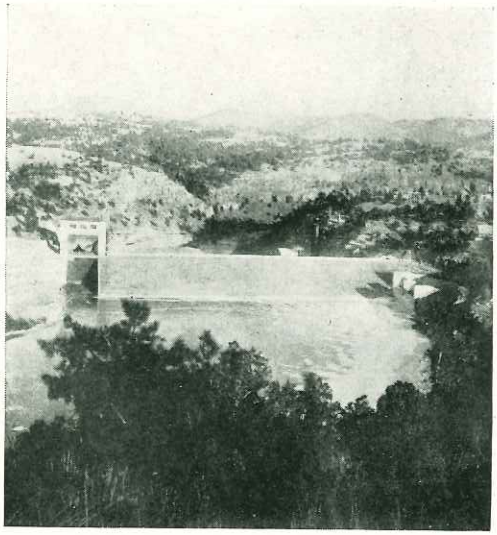
UNITED STATES RECLAMATION SERVICE—*Guernsey Plant*





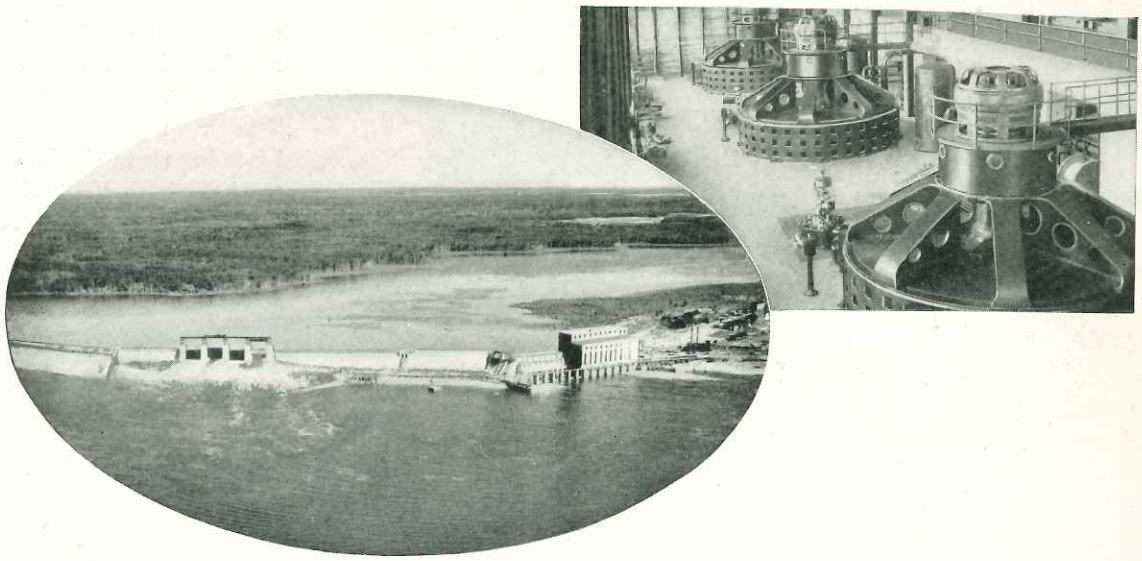
The Guernsey Dam, on the North Platte River in southeastern Wyoming provides additional water storage capacity for the North Platte federal irrigation district in Wyoming and Nebraska and also provides a head of from 40 to 90 feet for power development. The dam is a sluiced gravel and rock fill structure 105 feet high with a crest length of 560 feet and a base thickness of 1,000 feet. The spillway capacity is provided by a 30 ft. horseshoe shaped diversion tunnel. Water is supplied to the turbines through a 12 ft. tunnel with 8½ ft. steel penstock branches to the two units. The first turbine, installed in 1926, consists of a single vertical Smith unit set in a spiral casing and discharging through a vertical plate steel draft tube. The unit is rated at 3,400 H. P. at 240 R. P. M. under 65 feet head.

The shop views above show the assembly of the wheel case and cast iron generator support as well as the assembly of the babbitted turbine guide bearing with duplicate pumps arranged for mechanical and electrical drive to insure continuous circulation of oil.



MANITOBA POWER COMPANY—*Great Falls Plant*

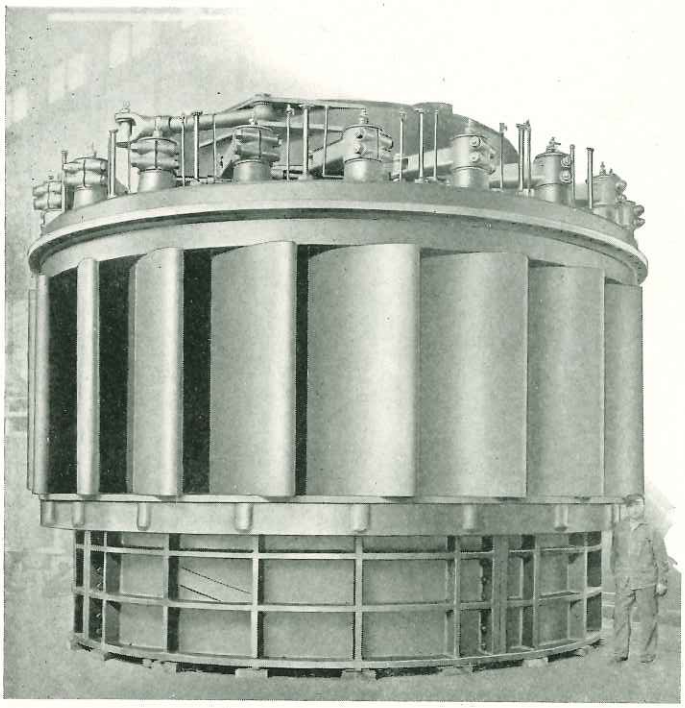
FRANK. H. MARTIN, *Consulting Engineer*



This installation includes a single vertical shaft high speed type Smith turbine in concrete scroll case discharging through an elbow type concrete draft tube. The rated capacity of this unit is 31,500 H. P. under 62 ft. head, operating at 138.5 R. P. M. Solid speed ring construction is used to insure correct alignment and ease of field erection.

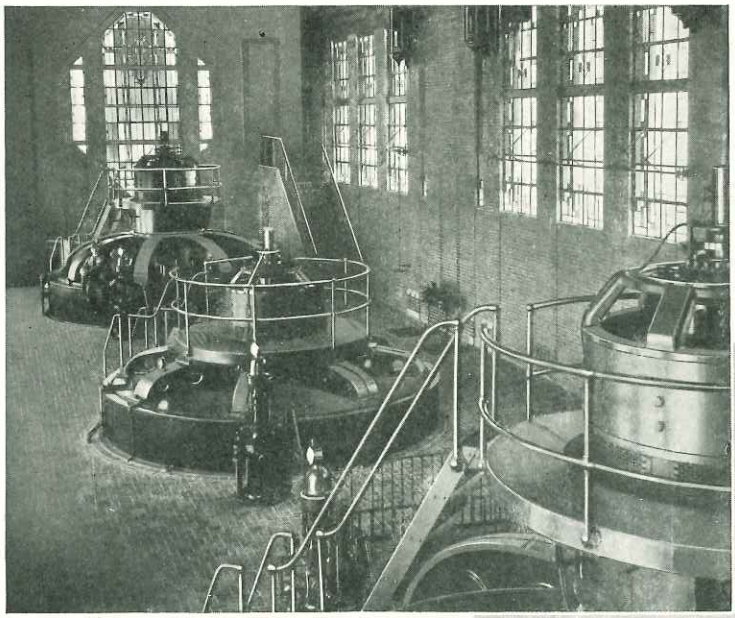
Exterior and interior views of the plant convey some idea of the immensity of this project, while factory views of the keyseating of the runner, also the assembled turbine without the speed ring, show the unusual size of the turbine parts.

The unit is controlled by an enclosed type Smith actuator as shown on page 62.

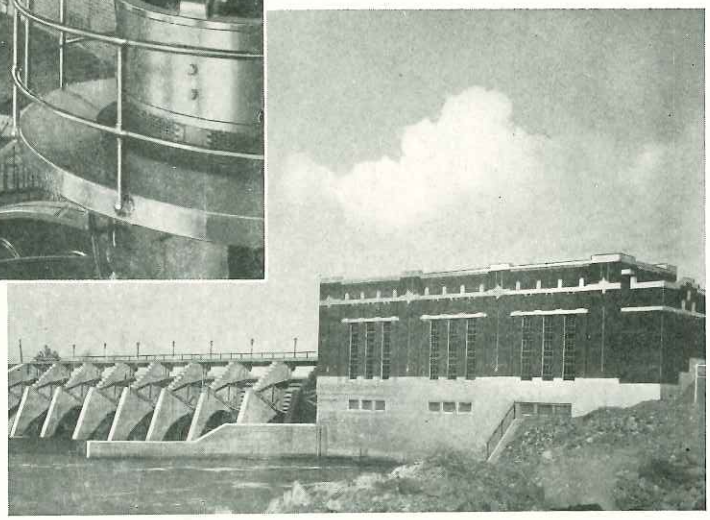


NORTHERN ELECTRIC COMPANY—*White Rapids Development*

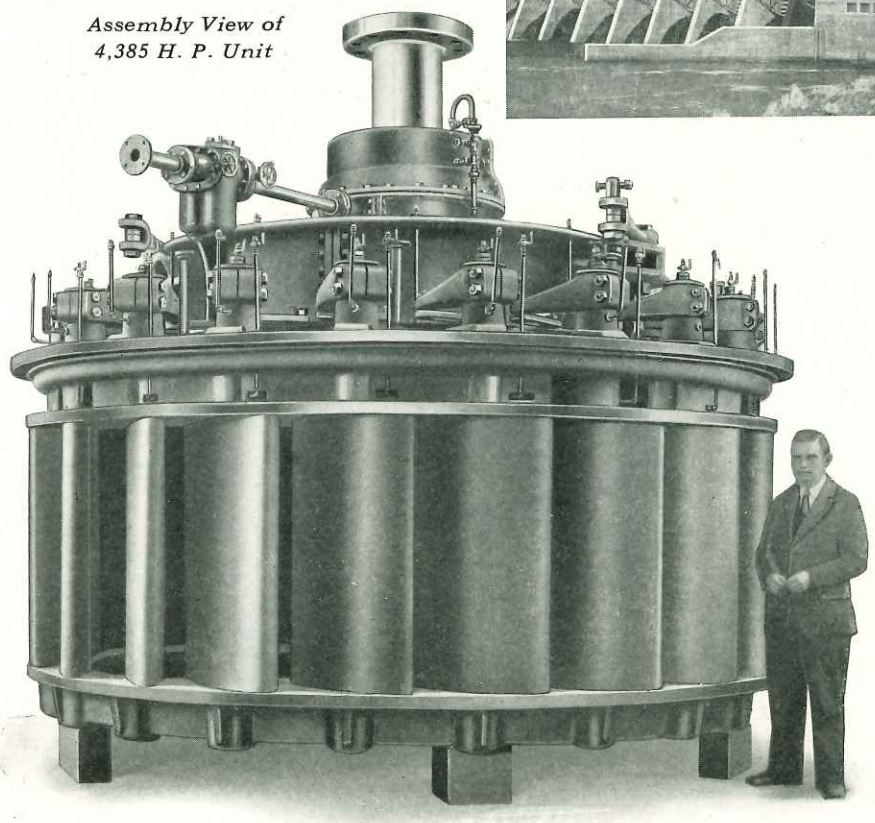
HOLLAND, ACKERMAN & HOLLAND, *Engineers*



A "Run of the River" proposition on the Menominee River about 75 miles north of Green Bay, Wisconsin, was developed by using three single vertical shaft Smith turbine units of different capacities.



Assembly View of 4,385 H. P. Unit

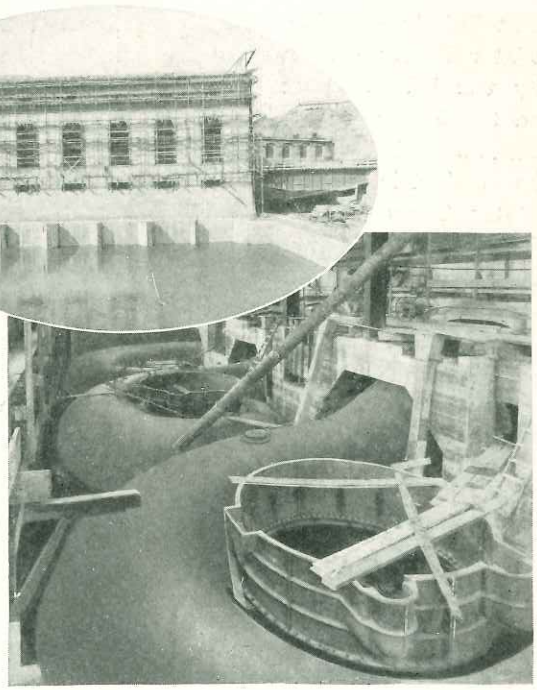


Two of these units develop 4,385 H. P. each at 100 R. P. M. under 29 ft. head. The third unit is rated at 3,100 H. P. capacity under 29 ft. head operating at 120 R. P. M. All units are of the speed ring type installed in concrete spiral flumes with vertical plate steel draft tubes.

Actual field tests show an efficiency of over 93%.

GREAT FALLS POWER CO.—*Black Eagle Re-Development*

CHAS. T. MAIN, *Consulting Engineer*



Views of the Power House Exterior and Interior during Construction

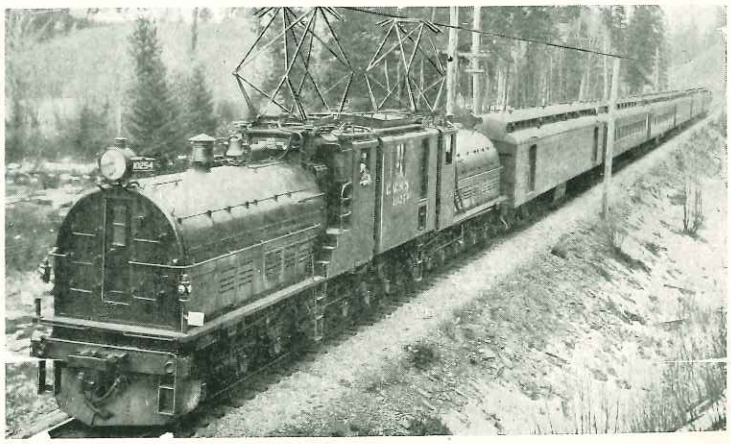
In reconstructing the Black Eagle plant of the Great Falls Power Co., owned by the Montana Power Co., on the Missouri River near Great Falls, the twin horizontal units originally installed in 1900 by the Boston and Montana Consolidated Copper and Silver Mining Co. were replaced with modern highly efficient hydraulic turbine equipment.

The new installation consists of three single runner vertical shaft high speed Smith turbines mounted in 14 feet inlet diameter steel spiral casings and discharging through concrete elbow type draft tubes. Each unit develops 9,300 H. P. at 180 R. P. M. under 50 feet working head.

These turbines are equipped with oil lubricated babbitted guide bearings with dual circulating systems. The governors are of the Smith actuator type.

With the completion of this installation a total of 255,000 H. P. is now being developed by Smith turbines in the various plants owned by the Montana Power Co.

The hydro-electric power generated on the Montana Power Co. system is chiefly used in the copper and silver mines and smelters and to operate the powerful electric locomotives which haul the trains of the Chicago, Milwaukee, St. Paul and Pacific Railway over the four ranges of the Rocky Mountains in the stretch of 660 miles of electrified railway.



LEXINGTON WATER POWER COMPANY—*Saluda Development*

MURRY & FLOOD, *Engineers*

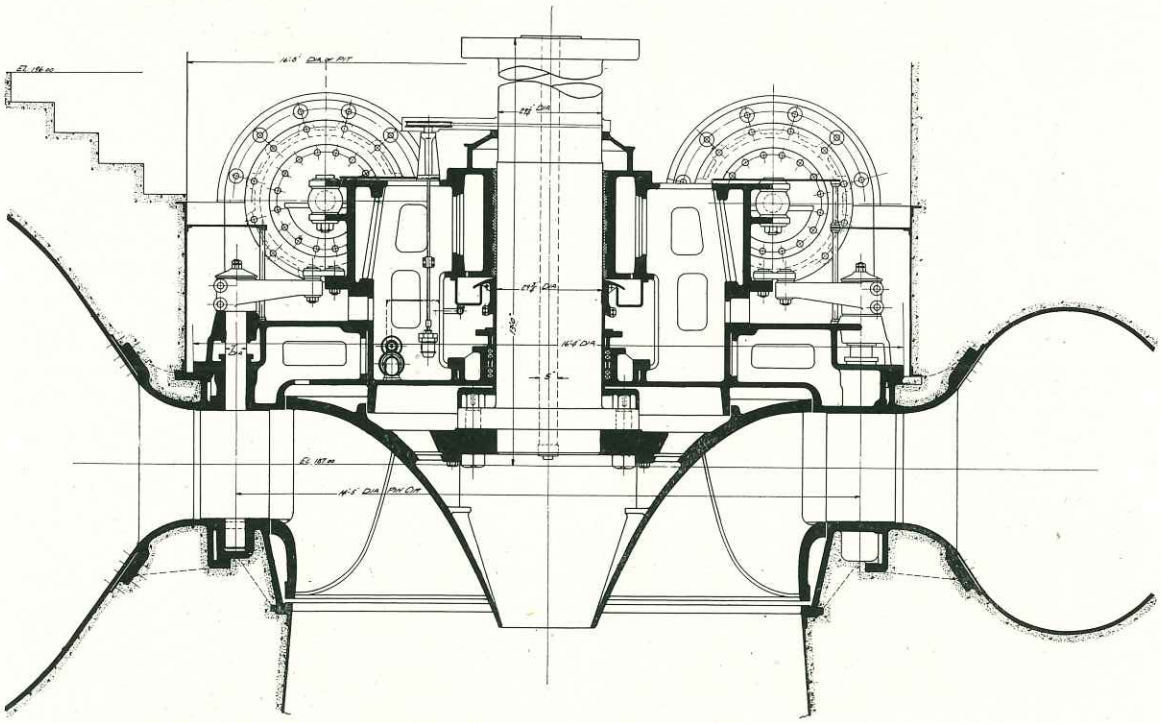
The Saluda Development of the Lexington Water Power Co., now under construction by the W. S. Barstow & Company, Inc., on the Saluda River near Columbia, South Carolina, will be one of the most important hydro-electric developments in the United States. The earth fill dam 206 feet high and 7,989 feet long will create one of the world's largest artificial storage reservoirs. With a shore line of 520 miles, the lake will be 41 miles long and 14 miles wide at the broadest point and will have a storage capacity of 93 billion cubic feet. It will require about ten months of average stream flow to fill the reservoir.

The initial installation will consist of four Smith turbines each rated at a maximum of 55,650 H. P. at 138.5 R. P. M. under 180 feet head. The ultimate development will be six units.

The turbines will be of the single runner vertical shaft type set in steel spiral casings and discharging through concrete elbow type draft tubes. The water will be brought to the turbines through steel penstocks 16 feet in diameter. A surge tank 206 feet high will be connected to the lower end of each penstock. A 16 foot diameter cast steel pivot valve will be supplied with each turbine in the penstock at the inlet to the spiral casing.

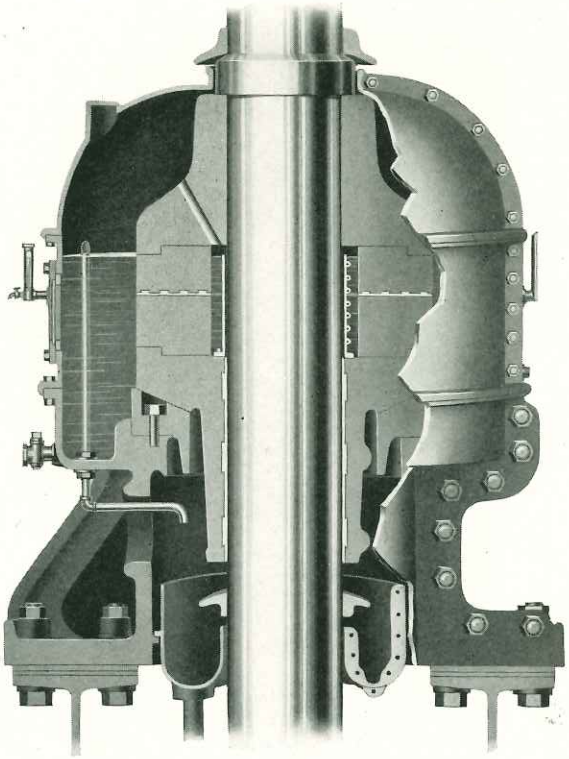
The accompanying cross-sectional view shows the general arrangement of the turbine parts and gives some idea of the size of these units.

At the present time we also have under construction four units of the same size and design for the Lower Fifteen Mile Falls plant of the Connecticut River Development Co. in Vermont which will develop 43,000 H. P. each at 138.5 R. P. M. under 165 feet head.



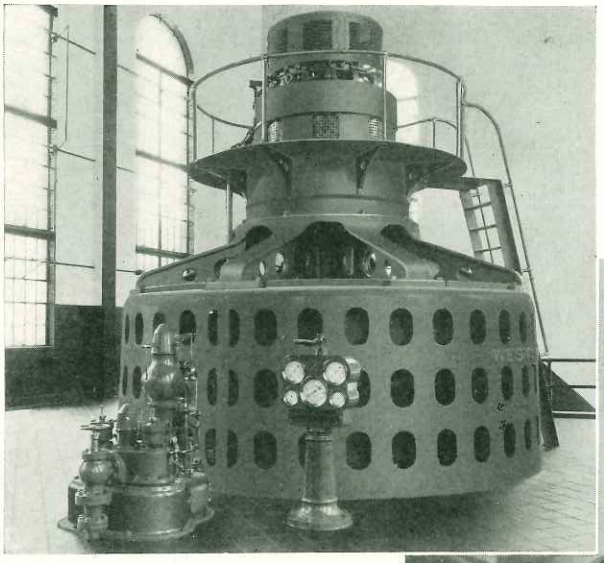
With these units we will furnish four hydraulically operated Dow Disc Arm Pivot Valves 16 feet in diameter and two 9′–0″ electrically operated valves of the same type. The New England Power Construction Co. is in charge of the engineering on this development.

GIBBS THRUST BEARINGS

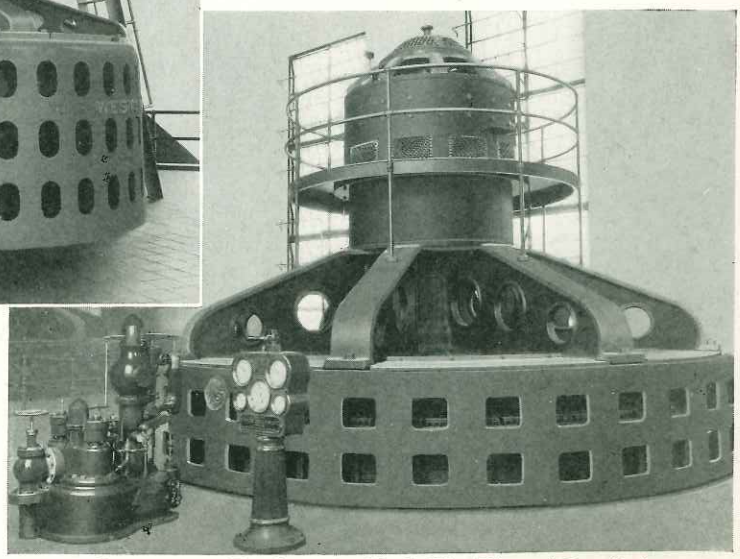


Several hundred Gibbs oil bath type thrust bearings for both vertical and horizontal shaft installations have been built and are in successful operation under various conditions carrying loads up to five hundred thousand pounds.

In order that when installed in place each bearing shall perfectly fulfill its proper functions, such extreme care is used in scraping the bearing surfaces to surface plates that there has never been any loss from failure of a Gibbs thrust bearing itself.



Gibbs Bearings are installed on the various makes of generators, on ship propeller shafts, pumps, etc. The unbalanced end-thrust on nearly all recent horizontal shaft Smith turbines is taken by Gibbs bearings.

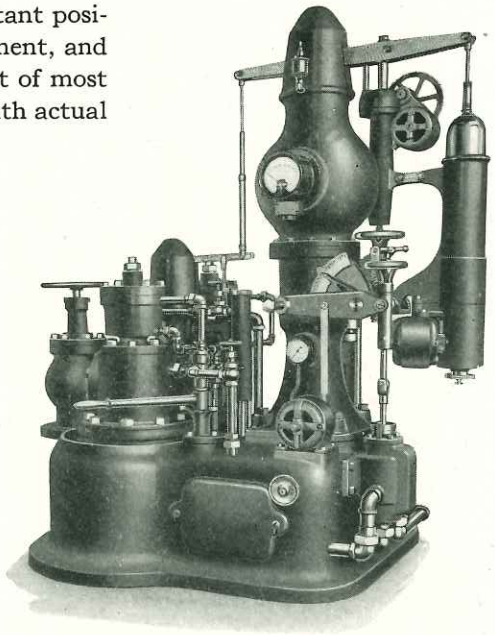


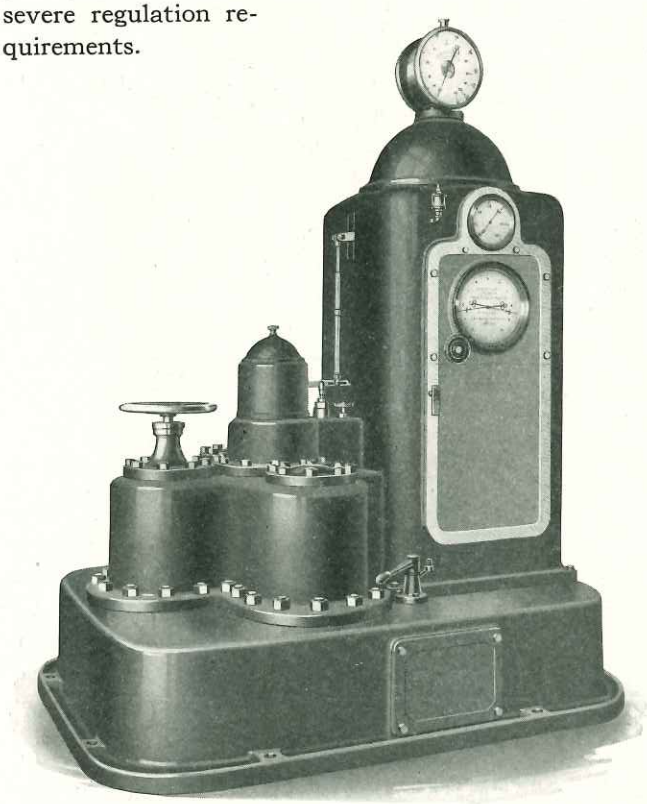
Generators Equipped with Gibbs Thrust Bearings

SMITH ACTUATOR TYPE GOVERNOR

S. Morgan Smith governors now occupy a most important position as accessories to Smith hydraulic turbine equipment, and their present high degree of development is the result of most careful design and many years of practical experience with actual operating conditions in the water power field.

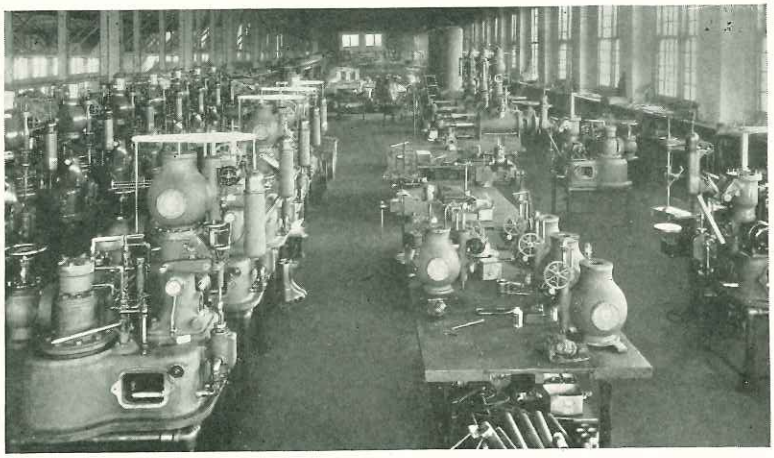
More than a hundred of the large actuator type governors have been installed and are in successful operation, some of them for more than fifteen years, under the most severe regulation requirements.





These actuators now in use, ranging in size from 35,000 to 230,000 foot pounds capacity each, with a total combined rating of over seven million foot pounds, are regulating more than one and a half million horse power of Smith turbines of from 4,000 to 50,000 H. P. per unit.

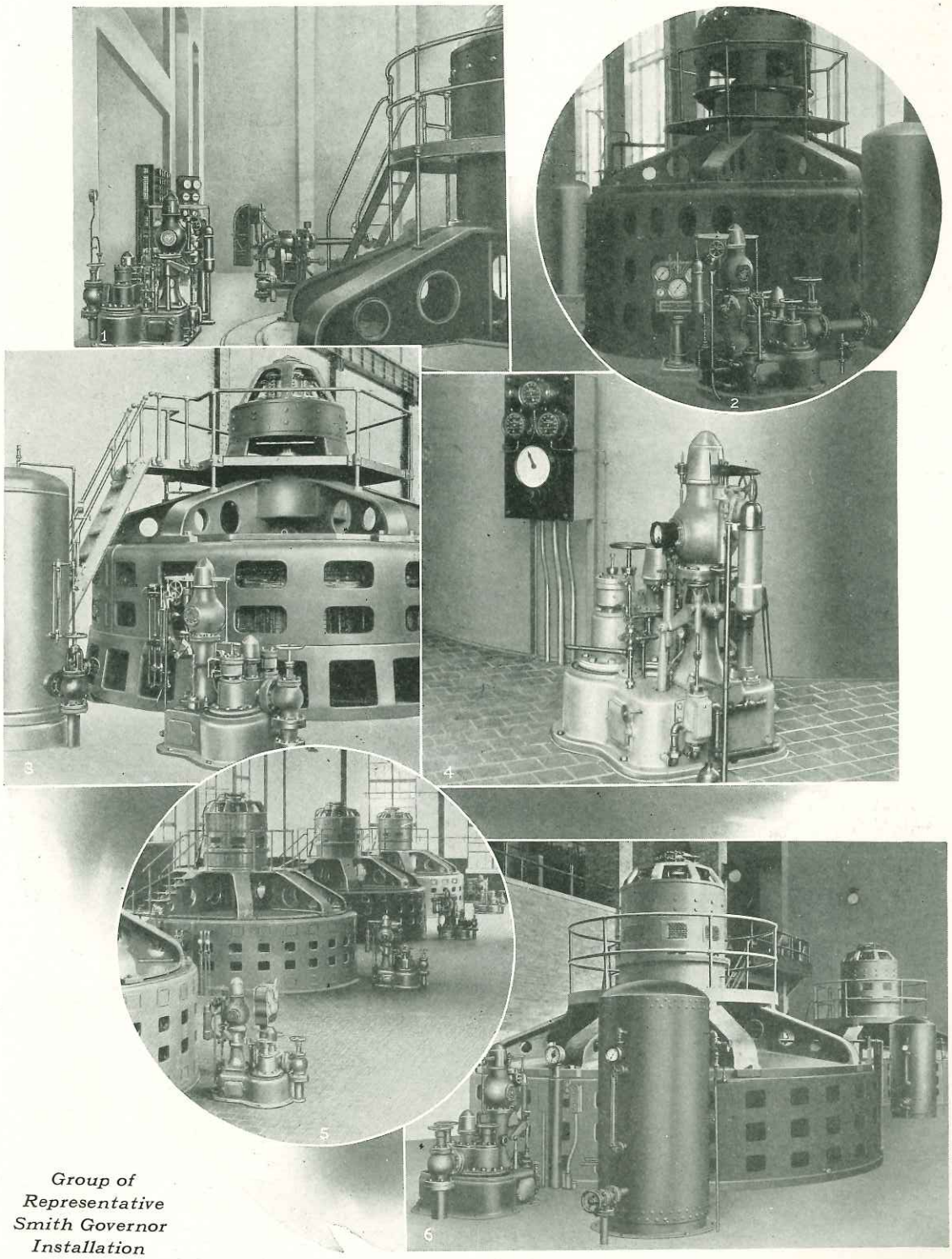
The standard type of actuator and also the enclosed type are here illustrated as well as a shop view of our Governor Department.



We also build the Smith gate shaft type governor in smaller capacities, together with the necessary pumping equipment. This type of governor is illustrated in detail on page 48.

On the opposite page are shown a few typical Smith governor installations.

A FEW SMITH ACTUATOR TYPE GOVERNOR INSTALLATIONS

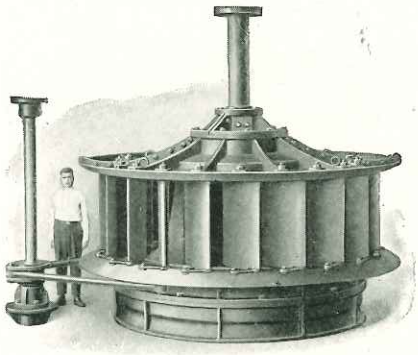


Group of Representative Smith Governor Installation

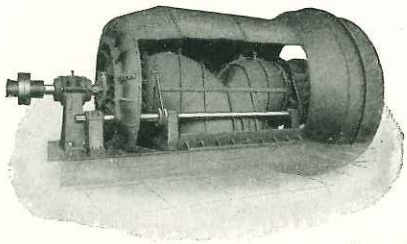
1. Sao Paulo Tramway, Light, Heat & Power Co., Rasgao Plant.
2. Connecticut Light & Power Co., Stevenson Plant.
3. Backus-Brooks Co., Norman Dam Development.
4. Columbus Electric & Power Co., Bartlett's Ferry Plant.
5. Georgia Power Co., Tugalo Development.
6. State of New York, Crescent Dam Power House.

SMALL AND MEDIUM SIZED SMITH TURBINES

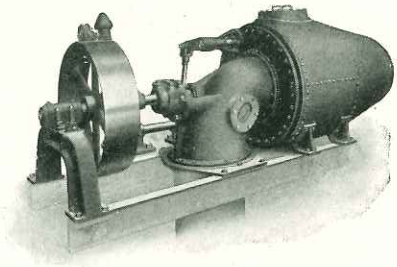
In addition to the turbine equipment illustrated on the previous pages, we also build small and medium sized turbines and their accessories. Our designs and patterns in this class of work are most complete. A few representative types of our smaller turbines are here illustrated. These turbines are fully described in other bulletins.



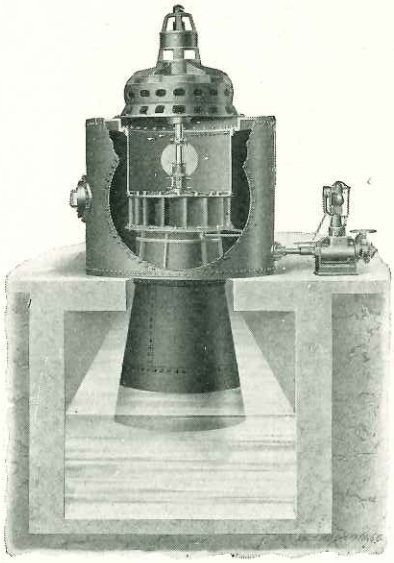
Standard single vertical turbine for open flume settings



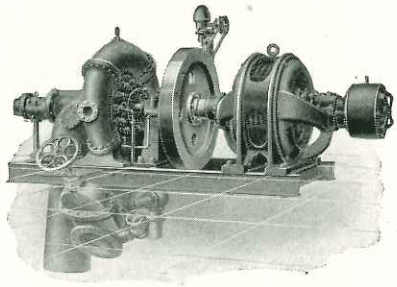
Pair of horizontal turbines in a plate steel pressure case



Single horizontal pressure case type turbine arranged for pulley drive



Vertical self-contained hydro-generating unit with the turbine mounted in a plate steel pressure case and direct connected to a generator on the case head



Horizontal cast iron scroll case turbine direct connected to a generator. Scroll case is sectionalized for mountain transport

If you are interested in developing hydraulic power, our engineering department will be pleased to make recommendations and to submit plans and estimates on the equipment best suited to meet your requirements.

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